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Peculiarities of Accumulators. VERY curious are some of the facts brought out in the section of Prof. Ayrton's paper published on another page. It seems strange, at first thought, that the electrical properties of a storage battery at any given time should involve the summary of its previous history, but we see, for example, that a long rest under charge may lower the efficiency for the next few cycles of charge and discharge by as much as 20 per cent. And yet we know very well that there is always going on in an accumulator a series of complex chemical changes, some of them irreversible and most of them imperfectly understood. In nearly a decade of commercial use, the real fundamental actions have been by no means completely explained. We hope that Prof. Ayrton will not rest in his investigations until he has cleared up the whole perplexing subject.

Electric Mining Machinery. WE are glad to show in the present issue an excellent specimen of successful mine equipment. No place is better fitted to exhibit the advantages of electric power than a mine, for in no place is power distribution by other means more ineffectual. Everything that makes the electrical engineering of such a plant difficult operates to the disadvantage of any other method. So far as efficiency goes, for the distances met with in mining practice, electricity is far ahead of any other permissible medium for the transmission of energy. Aside from this, the same properties of simplicity and easy management that tell in favor of the electric motor everywhere are special merits here. It is safe to say that the drudgery of mining will be much lessened in the next few years by the increasing use of electric mining machines, and it is notable that wherever they have been introduced the reports of their operation have been uniformly very favorable. This is the best possible evidence of practical commercial success.

Philanthropic Protection. How the hearts of electric light men must thrill with the pure joy of benevolence when they turn from happy contemplation of the tariff on copper to the day's quotations of copper stocks! Of course it is more blessed to give than to receive, and perhaps it should be unalloyed pleasure to think of adding one's mite to aid the poverty stricken mine owners. Nevertheless it is a tolerably well established principle that indiscriminate giving, even in such cases of actual need as those of the wretched recipients of 20 per cent. dividends, is not always productive of good; and it really seems as if this were perhaps a very proper subject for a carefully administered system of outdoor relief, rather than the present arrangement. Perhaps such an organization might materially reduce the annual contribution of two million dollars made by electrical industries to this particular charity, and replace it if necessary by a more modest and regular assessment. At least we feel that the National Electric Light Association might very appropriately take up the subject for serious consideration and take measures to call the attention of the public, especially certain influential capitalists of Washington, D. C., to the undesirable features of the present arrangement. Possibly they might be induced to take the initiative in a bitterly needed reform.

Electricity in the Census. WE are glad to see that the resolutions on a special census investigation of electrical industry, passed at the winter meeting of the National Electric Light Association, have been embodied in a memorial recently presented in the United States Senate. Surely if there be any subject worthy of exhaustive study it is the growth of electrical interests and manufactures. It would be hard, indeed, to find in the industrial history of the world another case in which a business has expanded to such colossal dimensions within the space of a single decade. When the last census was taken, aside from the telegraph and a comparatively small telephone service, there was little that could be said of electricity as a factor in the nation's prosperity. To-day electric light stations outnumber gas plants nearly two to one, electric motors are operated from no small proportion of them, and the number of electric railroads is fast sweeping along among the hundreds. A gigantic power, truly, in the advance of American civilization! No amount of painstaking labor is undeserved by it, and we hope that no trouble or expense will be spared by the government in making the census report as complete as possible. It is in excellent hands, and the small appropriation necessary would repay itself many times over in the immense mass of valuable facts that would be collected and the stimulus that would be given to continued and increasing electrical activity.

Welding with the Electric Arc. ON another page we present an account of the ingenious machinery and processes for welding by the aid of the electric arc, recently brought into notice by Mr. C. L. Coffin. The fundamental principles involved are radically different from those of the now well-known Thomson method. This latter utilizes the heating effect of a powerful current forced through a conductor, while the new process simply employs the enormous temperature of the arc under conditions that admit of exact regulation. As regards rapidity and perfection of work, we have not yet the data for comparison, but the arc process is found to make very satisfactory and reliable welds and to do it quickly and economically. Its great advantage is the fact that it requires no special generating apparatus and can be employed wherever an electric circuit, either arc or incandescent, is at hand. The magnetic blast enables the operator to keep the heat under perfect control, and to direct it as one would a blow-pipe flame. The arc is self-regulating, and the power required in the ordinary machines is but small; in fact, the welder is in this respect very nearly the equivalent of an arc lamp. For certain kinds of work the new apparatus seems remarkably well fitted by its power, cheapness in operation and convenience. It appears to be specially advantageous for welding hoops, rings, and the like, for which service it may be made nearly self-acting. It must be regarded as a very useful application of electricity to a wide and important field.

Belting for Dynamos. WITH the dynamo speeds now generally in use the subject of belting is one of prime importance, for in most cases direct coupling is out of the question; and while various clever devices for frictional driving have been introduced none of them has as yet come into general use. Nearly every engineer has his own critical ideas about belts, but we think there are few who will not find food for reflection in the facts given in the paper by Mr. Webber, published on another page The author is fortunate enough to have had a wide experience on the matters he has treated, and the experimental facts he gives will repay careful study. As to the advantage of great flexibility in belting there can be no question, and it is specially important when, as is the general practice in electrical work, rather small pulleys are driven at high speeds. With an area of contact necessarily limited, the stress on the material is high, and a very small resistance to bending will tend to produce slipping, that abomination of all dynamo tenders. Mr. Webber calls particular attention to the question of weight, and it is obvious enough that when the belted wheels vary considerably in diameter the centrifugal force may cause trouble. It would be very instructive to have experiments like Mr. Webber's carried out with his special aversion—the link belt. In using this, as is well known to our readers, it is run slack and usually over rather good-sized pulleys, so that the area of contact is considerably increased. The actual stresses and the dynamical properties in general of this type of belting would be an excellent subject for investigation. It is gratifying to learn that excellent results can be obtained without the use of solid leather, and Mr. Webber's tests should give some useful hints to manufacturers of every kind of belting. Definite experiments of this kind furnish the foundation for industrial progress.

Electrical Distribution. THE paper of Herzog and Stark on this very interesting and important subject, published in another column, has a practical value that can hardly be overestimated. So long as electric circuits are simple in character and limited in extent the computation of the necessary conductors is comparatively easy. But when, as in very many central stations, the dynamos feed a complicated network, covering a large and irregular territory, and supplied with a system of feeders running to distant points, the questions that arise are sometimes very difficult of solution. Specially is this true when a power service is combined with lighting upon a single circuit. In a previous paper [THE ELECTRICAL WORLD, May 3, 1890], the authors have developed at considerable length the mathematical theory of distribution in networks, and have shown the application of the resulting formulæ to various simple cases. In the present paper the subject is attacked from the practical side and the elaborate equations that result from the theoretical are simplified so that their application is far from difficult. But the part of their work to which we wish to call special attention is the beautiful theorem of electrical centre of gravity that permits ready solution of many problems arising in central station work. This idea, like many other important details of electrical theory, has for some time floated around among the more advanced thinkers on electrical subjects, and we are glad to see it so clearly enunciated by Messrs. Herzog and Stark. The principle is of the simplest character, and yet possesses the widest usefulness in the practical treatment of electrical distribution. Briefly stated, it is this: The fall of potential between any two points is a linear function of the current and resistance between those points. The truth of this is obvious from a consideration of the ordinary graphical treatment of the Wheatstone bridge or even of Ohm's law. It is also clear that unless there is change of the specific resistance by heating, two or more currents taken off at various points from a line supplied from a single source of potential can be considered separately. Then, since the fall of potential along a line is a quantity of the nature of a moment, being the product of the current and a linear function of the resistance, we can, so far as fall of potential and hence efficiency of line is concerned, replace n currents taken from different points of a line by a single current equal to their algebraic sum and taken from a point determined from the individual resistances, just as the centre of gravity of a material system is determined from the moments of its several points. A very easy application of this method would be to find the best point to tap a feeder into a given circuit and the sizes of wire to be used to ensure equal potential at all lamps. Or suppose a good sized motor is to be put on an incandescent line. Will the variation of current affect the lamps seriously? Find the change that would be produced in the electrical centre of gravity and you have an approximate answer at once. Again, the greatest possible change in voltage at a given point under ordinary service variations of load, and the amount the station voltage must be varied to meet the change, can be readily judged by the process in question. Herzog and Stark develop the method in a most practical way and give, beside, convenient graphical devices for arriving at the solutions of various problems in distribution. There can be no doubt of the desirability of avoiding the abstruse calculations that have beset the study of networks of electrical conductors, and the present paper has taken a long step in advance by arranging for graphical treatment the vital portions of the subject. We hope, therefore, that no electrician will be frightened off by the bristling array of determinant equations that confront him, when they are, after all, only the incidentals to most useful and beautiful practical methods of computation. Many of our every-day electrical processes depend on just such formidable signs and symbols, now hardly thought of since their results have become familiar.

NEW BOOKS.

ELECTRIC LIGHT FITTING. By J. W. Urquhart. 216 pp. 89 illustrations. Crosby, Lockwood & Son. London, 1890. $2.00.

This is professedly a practical book for practical men, dealing not so much with the details of electrical machinery as with the precautions to be taken in its care and use. Specially does it differ from most works of its class in that it handles very thoroughly the important incidentals to electric lighting indicated in its title. Indeed, we think it would have been improved by adhering even more closely to that branch of the subject. In particular the first few pages, dealing with the dynamo itself, could have been very well omitted, as they are not sufficiently complete to have much value and contain some statements that should be corrected. It is strange that there should be so much misapprehension as to the division of the current from a dynamo between the exciting shunt coils and the external circuit. Given the resistance of the shunt and the potential at the brushes and the current resulting is entirely independent of the load on the line except in so far as this may tend to change the potential by reason of the armature resistance and reactions. The effect of increased external output is to lessen the current through the shunt and not to increase it. Again it is perfectly well known to every one who operates incandescent machines that the neutral point shifts with the load, and that, consequently, in most machines the brushes must be moved to find the new non-sparking point. It seems as if the author's experience had been for the most part confined to arc machines.

Nevertheless the directions for the care and testing of station apparatus are for the most part very good and suggestive. It might, in view of their frequency, have been well to add to the notes on faults in the armature something relating to the detection of incipient short circuits. These generally occur on the head of the armature in Siemens wound machines, and are often most troublesome to detect, as they may only show when the armature is running and the wires under stress. In one case, an incandescent dynamo refused to give any considerable current or potential, did not heat, showed perfect connections on testing, and showed the same resistance between adjacent bars all around the commutator. Yet there was a short circuit, and it was only found by exciting the field magnets separately from another incandescent line and running the machine cautiously until the weak spot heated enough to disclose its position.

The hints to accumulator attendants are valuable. It is very easy to see from the perusal of a book like this how much more important a factor the accumulator is in English practice than in our own, and especially in isolated plants. Full directions for the care of such installations are unusual and certainly useful. Another variation from American practice is instanced by the instructions for running alternators in parallel—not a difficult operation when care is used, but one that scarcely enters the mind of the average electrician here. In fact, in spite of the very extensive use of alternating apparatus in this country, the subject is most insufficiently treated in books on electric lighting.

The later chapters of the work, dealing with fittings proper, are very instructive, especially as giving an insight into details of installation that are not altogether familiar to us. Much can be learned from the study of other people's methods, particularly when the conditions that have served to evolve them are those toward which our own surroundings are likely to tend. As electric lighting gradually settles into more definite commercial relations the rush and hurry that constitute the characteristic fault of American installation work will give way to more permanent and thorough methods. The change has already begun, and while it is unlikely that English methods will be extensively adopted, much may be learned both from their advantages and their faults.

Comparative Tests of Leather and Canvas-Rubber Belts.

BY SAMUEL WEBBER, C. E.

The question of belting for driving the high speed dynamos in electric light and power stations, is one of considerable importance, and one on which I am often called to express an opinion.

In the first place, let me lay down as a general law, too often neglected, that the value and driving power of a belt depends upon its complete flexibility, and also on its evenness and softness of surface; which two qualities combined permit perfect contact with, and close adhesion to, the surface of the pullies. The next point is the weight of the belt itself, which should be as light as possible, consistent with the extreme power to be transmitted by it. This not only saves waste of power in keeping the belt itself in motion, but reduces the centrifugal action that tends to keep the belt from coming in proper contact with a small pulley at high speed. This matter, though important, is often overstated, much of the trouble often noticed being due to the rigidity and inflexibility of the belt, particularly if a double one, rather than to its centrifugal action. If any one has ever noticed the action of one of the great cotton mill belts, at Lowell or Fall River, running at a speed of a mile a minute, on a pulley 5, 6 or 7 feet in diameter, he will remember that he has never seen much centrifugal action keeping the belt away from the pulley; but if he has seen a double belt even at 3,000 feet per minute run on a 12 inch pulley, he will have noticed a perceptible loss of contact.

For these reasons I would always discourage the use of a double belt, when a single one will answer the purpose on any reasonable width of pulley, or in any case when the pulley is less than 12 inches diameter. Belts can be run as fast as 6,000 feet per minute with perfect safety, and if flexible, will cling to the pulley, and lose nothing by centrifugal action. The consideration of weight leads me to disapprove of the so-called "link belts." Even with the latest, and I believe the best of these belts, the "Acme" belt of the Page Belting Company, of Concord, N. H., the weight of the belt is given me as four pounds four ounces per square foot, of which three pounds three ounces is leather, and one pound one ounce iron.

Now, a first-class single leather belt, 3-16 inch thick, weighs just about one pound per square foot, and I believe that an equal weight of leather in its normal and natural condition will transmit more power, with less loss, than if chopped up into scraps and bolted together again, in any way whatsoever.

The cost of leather has led to very many experiments to provide an economical substitute, and the first one of these to notice is the "rubber belt," or, in other words, a belt composed of several folds of canvas, covered and cemented together with a solution of India rubber. For work in dye-houses and bleacheries this has proved very valuable; but it is soon destroyed by heat and dust, and I am not aware that it has been successfully used as yet for electrical purposes; in fact, with one exception, the cotton-leather belt, of which I shall speak later, I do not yet know of anything to contradict the old saw, "There's nothing like leather."

I give herewith the results of a series of experiments made by me at the factory of the Underwood Belting Company, Tolland, Conn., to test the comparative driving capacity of various entirely new belts.

The first test I will note was of an entirely new Hoyt belt, one of the best known on the market. This had been in stock some time, but was tested as it was for the sake of information.

This belt was 12 inches wide, ¼-inch thick, 31 feet long, and weighed 34½ pounds. With a tension of 43½ pounds it drove 7 h. p. (at 754 feet per minute) and then slipped off from stiffness and lack of sufficient tension. The strain was then increased to 62½ pounds per foot, and the belt shortened, in doing so, 4½ inches. It now carried 7.77 h. p. at 697 feet per minute, and with a load of 11.64 h. p. slipped 10½ per cent., and slipped off when the load was increased.

The strain was then increased to 83½ pounds per inch, which shortened it 2½ inches more, and it now carried 8.88 h. p. at 697 feet per minute without slip. As more load was added it began to slip, increasing until with a load of 14.77 h. p. at 660 feet per minute it slipped 13 per cent. and with increased load slipped off. The belt was then reversed, bringing the softer flesh side to the pulley, the hair side having been previously used. It now carried 16.85 h. p. at 662 feet per minute, and then "jumped the pulley" suddenly with increased load, without having shown any perceptible slip previously. This test showed that on the polished iron pulley, the soft-flesh side *held* better than the harder *grain*.

A pair of Dodge's wooden pulleys were now put on and the belt replaced, with the hair side to the pulley. We now got 15.29 h. p. without slip, at 739 feet per minute, but additional load caused a slip which increased with the load, so that little more power was shown and the test was stopped at 15.80 h. p. with the belt still on the pulleys, showing a horse power for each inch of width, at 562 feet per minute.

The next test was to cut the belt down to 8½ inches wide, which gave an apparent strain of 117.6 pounds per inch, as it was simply relaced in the old holes. This on the wooden pulleys, gave 10.19 h. p. without slip at 711 feet per minute, and 11.79 h. p. with a slip of 3.77 per cent. at 699 pounds and then went off with increased load.

A pair of paper pulleys from Westinghouse, Church, Kerr & Co., were then substituted and the belt replaced as in the last trial. It now gave on these pulleys 15.69 h. p. without slip, at 704 feet per minute or at the rate of 1 h. p. per inch, for 374 feet velocity. This finished the trials of this belt, which came out as good as new and had not stretched an inch when we got through with it.

We will now compare this with a series of tests of a very soft and flexible belt, known as the "Schultz Rawhide Belt," under the same conditions.

This belt, 31 feet long, 12 inches wide, and 3-16 inch thick, weighed 29 pounds.

It was first tried, as before, with a strain of 43 pounds per inch on iron pulleys, grain side to the pulley. This likewise proved to be an insufficient strain, and after giving 6 h. p. without slip, and 9.48 h. p. with a slip of 8.43 per cent.; at 725 feet per minute, it went off the pulley with increased load. With the increase of strain to 62½ pounds per inch it gave 11.10 h. p. at 697 feet per minute, and 16.27 h. p. with 5.66 per cent. slip at 675 feet per minute, slipping off with increased load.

With a strain of 83½ pounds per inch we got 15.79 without slip at 667 feet per minute, and 19 h. p. with 5.66 per cent. slip at same speed, going off with increased load. This showed 421 feet per minute per horse power per inch.

We then put on the wooden pulleys, relacing the belt in the old holes, and got 19.80 h. p. without slip at 691 feet per minute, and 26.16 h. p. with a slip of 3 per cent. at 705 feet per minute. With an additional load we got 26.87 at 693 feet per minute with a slip of 4.59 per cent., and with more load "stalled the engine."

This last test showed 309 feet per minute per horse power for each inch of width, and fairly illustrates the difference between a stiff and a flexible belt.

We, however, split this belt down as we had the other one to 8½ inches wide and repeated on the wooden pulleys. Lacing in the old holes, we now got the strain of 117.6 pounds per inch, which proved too much for the belt, for although we now got 22 h. p., at 691 feet per minute, *without slip*, or at a speed of 261 feet per minute for each inch of width, the belt "jumped the pulleys" with the next increase of load, and when we tried it on the paper pulleys we only got 16.46 h. p. without slip, at 739 feet per minute. The belt slipped off with the next increased load, and on applying the scales we found that the tension had fallen to 77.7 pounds per inch, and on taking it off we found it permanently stretched 1¼ inches. We were perfectly aware all the time that we were overloading the belt, but our object was to find how much it would stand.

These experiments confirm the already well established fact that a leather belt will safely bear a strain of 350 pounds per square inch of area, or 87½ pounds per inch of width for a belt one-fourth inch thick, or 66 pounds for one of $\frac{3}{16}$ inch, or an ordinary single belt, and that the latter in good condition, soft and flexible, will easily convey one horse power for each inch of width at 600 feet per minute. They also show very plainly the difference in the hold on the pulley of rigid and flexible belts, and this difference would increase with the velocity on small pulleys, as both the centrifugal force and the entrainment of air would be greater. An ingenious perforated belt for high speed has been introduced lately by Messrs. Chas. A. Schieren & Co., of New York, which I have not seen in operation, but of which the samples impress me favorably. The slight longitudinal perforations are not sufficient to materially weaken the belt, while at the same time they afford an easy passage for entrained air.

I may be thought severe on "link-belts," but my opposition to them is based on sound mechanical principles, for high speed, and if a great power at low speed is required. When shafts and gears are impracticable I should use a metallic link or chain on "sprocket pullies," rather than trust to friction. With these remarks, I will leave the subject of "leather," and turn to my notes on canvass belts of different kinds. The series of experiments to which I have referred, shows a test of a simple canvass or duck belt without any preparation. This belt, 31 ft. long, 12 inches wide, 3-16 inches thick, weighed 21½ pounds. It stretched 13½ inches, with a strain of 43½ pounds per inch, gave 4.86 h. p. without slip at 754 ft. per minute, slipped 3.83 per cent. with 5 h. p., and slipped off with increased load.

When saturated with size, under a strain of 83½ lbs. per inch, it carried 5.75 h. p. without slip, at 739 ft. per minute, then began to slip as the load was increased, until it went off after gixing 10.35 h. p. with 9 per cent. slip.

Next came a "Main" or "Gaudy Belt," 31 ft. long 12 inches wide and 33-16 thick weighed 41½ pounds. It was composed of heavy cotton cloth, folded and stitched, and saturated with oil and red paint. It stretched 13½ inches before lacing with the srtain of 43½ pounds per inch. It carried 7.20 h. p. without slip at 754 ft. per minute; with 8.43 h. p., it slipped 8½ per cent., and went off with increased load. With a strain of 62½ pounds per inch, it stretched 2 inches more, and drove 8.08 h.p. without slip, at 725 ft. per minute, slipped 8.70 per cent. with 9.48 h. p., and then slipped off. With 83½ pounds per inch, it stretched 3 inches more, and carried 10.48 h. p. without slip at 732 ft. per minute. With 14.22 h. p., it slipped 10 per cent., and then went off.

Next comes a four-ply duck belt, weighing just one pound per foot, and saturated with linseed oil and plumbago. This stretched 7½ inches with 43½ pounds per inch, and drove only 2.40 h. p. without slip, it having been dusted with powdered soapstone, to keep it from sticking together in the fold. The soapstone got rid of, and the strain increased to 62½ pounds per inch, it carried 13.27 h. p. without slip, and went off with an increase of load. At 83½ pounds per inch, it carried 16.65 h. p. without slip at 697 feet per minute, but slipped 5.71 per cent. with 17.28 h. p. and then off.

A first-class rubber belt of same dimensions, weighing 37 lbs., showed *no slip* in any test until it finally *jumped* the pullies, giving 8.07 h. p. at 725 feet per minute, with 43½ pounds strain; 13.68 h. p. at 660 feet per minute, with 62½ pounds strain, and 18.61 h. p. at 650 feet per minute, with 83½ lb. strain, the last test starting the rubber covering. The variations in speed are due to the incapacity of the engine to carry these loads in addition to its regular work.

We now come to the cotton duck leather-lined belt already mentioned. This belt was a four-ply duck, with a soft leather lining cemented on, and weighed 37½ pounds, of the same size as the others, but was ¼ inch thick, or in. duck and $\frac{1}{16}$ leather. It stretched 2½ inches with 43½ pounds, and drove 10.80 h. p. without slip at 754 ft. With 12.4 h. p. it slipped 13 per cent., and then slipped off,

With 62½ pounds per inch strain it carried 11.88 h. p. without slip at 747 ft. per minute, stretching 2½ inches.

It carried 19.40 h. p., with 14.7 per cent. slip at 711 feet, and then slowed down the engine without going off. With the steam increased to 83½ pounds, it carried 16.98 h. p. without slip at 711 feet per minute, and with 21 h. p. and nine per cent. slip slowed down the engine to 690 feet, and the test was stopped with the belt still on. All these last tests were on iron pulleys. We now changed to the wooden ones, and got 27.87 h. p. without slip, stopping the engine.

We then split the belt down to 8½ inches, or 117 pounds per inch, and on the same pulleys got 25½ h. p., with one per cent. slip. Changing to paper pulleys we got 25.30 h. p. *without* slip, but exhausted our power as before, and on applying the scales found the belt to still hold its strain of 1,000 pounds. As will be seen from the above tests, we could not get higher speed with these belts, so we took a five-ply belt of same kind, 5 inches wide, $\frac{5}{16}$ inches thick, 31 feet 2 inches long, weighing 19 pounds. This stretched 2½ inches under a strain of 77 pounds per inch, and gave 7.20 h. p. on iron pulleys without slip at 754 feet per minute. With 9.80 h. p. it slipped 3½ feet, and with increased load slipped off. On wooden pulleys it drove 10.19 h. p. without slip at 711 feet per minute, or at the rate of 348 feet of belt per minute for a horse power to each inch. We then put back the iron pulleys and increased the strain to 117 pounds per inch, and got 10.29 h. p. without slip at 718 feet, and 12.63 h. p. at 698 feet, with 5.65 per cent. slip. We then put on a larger pulley to increase the speed, and under the same strain got 18.62 h. p. without slip at 1,301 feet per minute, and 24 h. p. with 1.50 per cent. slip at 1,276 feet, 24.59 h. p. with 3.10 per cent. slip, and 24 h. p. with 5.50 per per cent. slip at 1,222 feet per minute, slowing down the engine so that we could not continue the tests. These last two tests, however, go to prove that the slip does not increase with the velocity, and the last three were all stopped in good order, with the belts still on the pullies. I think they go to prove that a strong light-woven belt, with a leather lining, if the cement is perfect, will be the belt of the future for all magneto-electric machines, as they combine great strength with light weight and great clinging properties.

I do not propose to enter into any discussion which may involve patent rights, but will simply say that while these cotton-leather belts tested were made by the Underwood Manufacturing Company, a very promising belt of the same materials is also made by the Page Belting Company, of Concord, N. H., differing in construction thus: Two canvas belts are used, meeting in the centre, with a single leather lining, which acts as a hinge, and permits the belt to adapt itself closely to a *coned* pulley.

A Model Mine Installation.

The Willock mine, belonging to the Monongahela Gas Coal Company, and situated in the first pool of the Monongahela coal region, is now operated with a complete electrical plant. Alternating current motors are utilized as a source of power in the production of the coal, the working of the pump, and also in the manipulation of an enormous ventilator which keeps a constant draught of pure air in the mine. In addition to that, the mine is also illuminated by the alternate current system. The electrical equipment was designed and installed by the Mill and Mine Electric Equipment Company, under the supervision of Mr. W. A. Giles, general manager and electrical engineer for the company. Mr. John Werner is superintendent of these mines.

The plant consists of a 30 h. p. quarter phase generator of a capacity sufficient to carry seven motors when cutting coal at the limit of the capacity of the coal company. The generator is self-exciting, self-regulating and so wound that as the load increases the E. M. F. rises. By the aid of a hand rheostat the adjustments can be so made that the falling off in the speed of the engine and the drop in the line may be compensated for so that at the motors a very close approximation to constant E. M. F. is obtained. After the hand rheostat is once adjusted it is unnecessary to make further adjustments, for the regulating devices are automatic. Three wires are carried from the collector at the end of the generator shaft to the switch board and pass through the switch board instruments and main line switches directly into the mine. On the switch board is a direct reading voltmeter and an ammeter. The E. M. F. at the motor is 300 volts in this installation.

Where the distances become very great, a higher E. M. F. may of course be used. The mine is wired with Clark rubber covered wire and the insulation of each wire is practically continuous from the time the wire leaves the main switch in the power house until it reaches the end of the circuit. At the entrance of each room and also at convenient points throughout the mine, switches are located and safety catches inserted. This insures safety from short circuiting and also allows any portion of the circuit to be cut off from the generator without interfering with the work in other parts of the mine. From the switch in the room to the coal-cutting machine the current is carried by a three-wire cable. This cable is highly insulated and covered with a protecting braid, so that, though it is frequently allowed to lie on a damp floor and even in pools of water, no inconvenience is noticed.

Owing to the simplicity of the motor it is necessary only to have a jaw switch at the motor with which the circuit can be opened and closed. No regulator of any kind s used. The only auxiliary apparatus connected with the motor, with which the operator of the machine has any thing to do, is the switch to turn the current on and off. The motor is completely covered.

Six Hercules coal mining machines with a 3 h. p. Tesla motor mounted upon each are now in operation in this mine. The machine and motor complete weigh about 1,000 pounds, and are easily handled and shifted from room to room by one man. A special truck is used in conveying the machine from one room to another. These machines, by means of a set of gang bits or augers, make an undercut three inches high, 36 inches wide by 42 inches deep. One man, with this machine, will average 40 cuts or about 43 tons of clean coal in 10 hours. This is equal to the product of 12 to 14 pick miners.

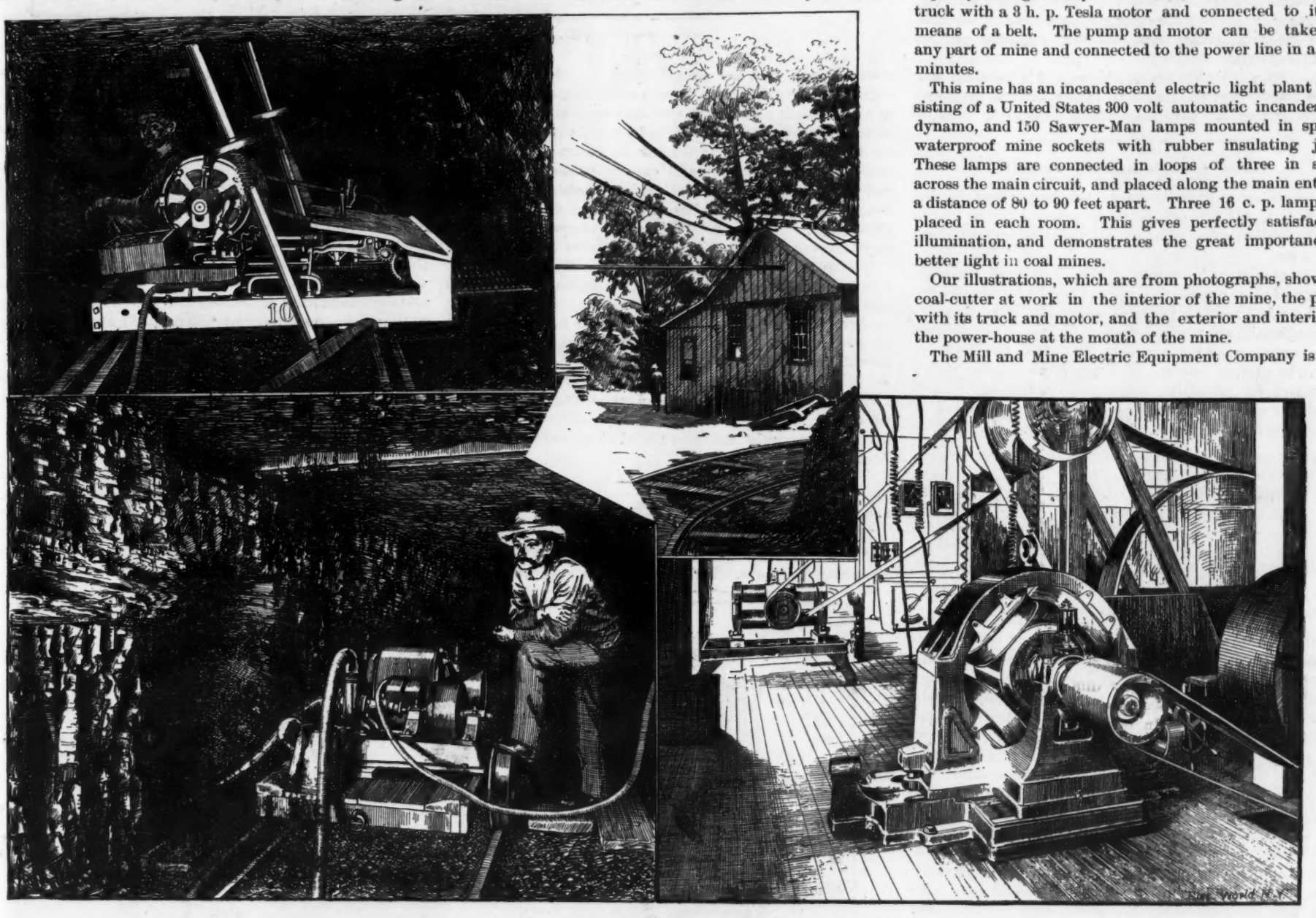
The ventilating outfit in this mine consists of a 12 foot Pollock fan situated at the bottom of a shaft 75 feet deep, and is so arranged that fan can be changed from an exhaust to a blower in five minutes. This fan is run with a 3 h. p. Tesla motor.

The pumping outfit consists of a centrifugal pump of a capacity of 90 gallons per minute, mounted on the same truck with a 3 h. p. Tesla motor and connected to it by means of a belt. The pump and motor can be taken to any part of mine and connected to the power line in a few minutes.

This mine has an incandescent electric light plant consisting of a United States 300 volt automatic incandescent dynamo, and 150 Sawyer-Man lamps mounted in special waterproof mine sockets with rubber insulating joint. These lamps are connected in loops of three in series across the main circuit, and placed along the main entry at a distance of 80 to 90 feet apart. Three 16 c. p. lamps are placed in each room. This gives perfectly satisfactory illumination, and demonstrates the great importance of better light in coal mines.

Our illustrations, which are from photographs, show the coal-cutter at work in the interior of the mine, the pump with its truck and motor, and the exterior and interior of the power-house at the mouth of the mine.

The Mill and Mine Electric Equipment Company is now putting a similar equipment in Mr. Frank Armstrong's Summer Hill mines at Woodville, Pa.



ALTERNATING CURRENT APPARATUS IN A PENNSYLVANIA COAL MINE.

Trouble from Electric Railway Currents.

To the Editor of The Electrical World:

SIR: In your issue of the 26th inst. I notice an article relating to "Electric Roads and Telephones." The tone of the writer attracted my attention, as he seems willing that the electric roads should *monopolize* the *ea th*, whether they own it or not, and as possession is said to be nine points of the law, some of them at least seem to have these nine points.

I am not a telephone man, but have charge of quite a number of wires used for various purposes, such as electric time, fire alarm, district messenger telegraph and others. In Ansonia, Conn., we have an electric road, operated between there and Derby and Birmingham, a distance of about two miles, which is greatly appreciated by the public in general; but it renders nearly useless all circuits that have either permanent or temporary grounds on them.

The telephone service has been rendered almost useless, thereby inconveniencing the business men generally. Metallic circuits have been erected in several cases, but the subscriber has had to pay an advanced rate of rental.

The electric road company has made several changes to avoid the difficulty of escaping current, which appears to be due to imperfect contact in the rails; and after the contact has been made good the trouble ceases for a while, but in a short time reappears again as bad as ever. But the telephones are not the only circuits affected; all ocal battery circuits are affected, on account of the

current returning through these wires that may be grounded.

If the direction of the escaping current from the electric road would always flow over these wires in the same direction, the battery circuits might be operated more successfully by reversing the batteries to correspond with the direction of the road current; but the latter changes its direction whenever a car is at either end of the line, so that when the car is at one end the current in the battery lines will be increased, while if the car is at the opposite end the current will be in the opposite direction to the batteries, thereby reversing them.

It hardly seems fair that any one enterprise should be allowed to operate in a way that damages all other enterprises using electricity as a motive power. Why are not the electric light companies allowed to ground their wires as well as the electric road companies? It would seem as though they had the same right.

I notice in the article referred to that the electric road companies have offered to pay for metallic circuits on all existing lines of the telephone companies; but what about other electric companies? will they pay for metallic circuits for them also? and are electric roads to have the sole use of the earth, so that other electric companies cannot use it temporarily at least?

I, for one, am glad to see the electric roads prosper, but do not believe they should get their prosperity to the detriment of others. Very respectfully yours, W.

Closed Electric Railway Conduit.

An enormous amount of energy has been spent by inventors in trying to work out the practical solution of the very difficult problem of electrical traction without overhead wires.

All sorts of plans have been schemed to avoid the trouble, and of these one of the neatest we have seen is the closed conduit recently patented by Mr. C. J. Van Depoele. Its peculiarities are readily seen from figures. Fig. 1 shows the arrangement of the little sub-structure in the roadway. As will be seen, it consists of a very small conduit with a slot above for admitting the contact device, but almost completely closed by flexible lips which are only separated as the plow attached to the car and carrying the brushes

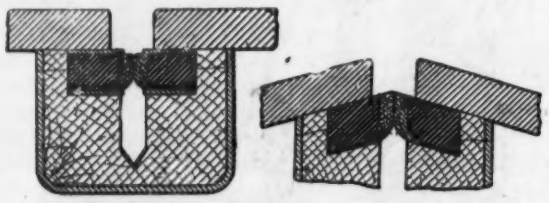


Fig. 2.—Closed Conduit System.

or rollers forces them apart. We have, then, a slot which is normally completely closed by flexible walls. The thin plow simply separates these enough to allow of its passage so that with the exception of a short space immediately under the car and almost entirely filled by the plow the conduit is closed in such a way as to exclude dirt, dust, and even water. Of course it is almost hopeless to expect that nothing of these could make its way into the conduit, but a very large proportion of the disturbing intruders must be kept permanently out.

As shown in Fig. 1, the conduit itself may be very small, and the main conductor may be carried with cable underneath it and tapped into the conductor strip at intervals. If the flexible walls can be made so as to retain their elasticity and be reasonably long-lived, very much of the trouble that has heretofore stood in the way of the development of conduit traction will have been removed. Rubber in various forms, packing strips of canvas or duck, permeated with waterproof insulating compounds and supported by metallic strips, fibrous packing of various sorts, alternate strips of rubber and canvas, and fibrous packing strips driven with sufficient elasticity by steel spring, are among the forms proposed.

One of the most promising is shown in Fig. 2, where the elastic packing is formed in two portions as shown. If faced of leather, backed by rubber to give the necessary spring, the leather forms a surface that promises to wear well. The contact devices may be placed freely in the bottom of the watertight conduit and the current collected from them by almost any kind of shoe or roller of metal or carbon and in almost any form. The success of the scheme, of course, depends directly on the durablility of the elastic material—not only its power of actually resisting wear, but of retaining its elasticity so as to completely close the slot. If it were necessary still further to lessen the leakage which is almost unavoidable in conduits of any kind, it might be done by securing in connection with the present device some one of the forms of sectional conductor which have been from time to time proposed.

A Compact Steamship Lighting Plant.

The new lighting plant for the steamship "Seguransa," which is now in process of installation, is illustrated on this page. The plant consists of a Ball engine and a Continental dynamo, coupled direct, and intended to run up to speed of 400 revolutions per minute.

The engine is rated at 27 h. p., is direct acting with vertical cylinders and is connected to the dynamo by a flexible coupling. The specifications call for a speed of 400 revolutions when the dynamo is giving its maximum output. It is intended to work with a steam pressure of 100 pounds.

The dynamo has a capacity of 400 incandescent lamps of 16 c. p. each. It is compound wound and perfectly self-regulating. It is mounted upon a rubber base to prevent any undue noise arising from the necessary vibration of the plant when running at such a high speed. All the main iron part of the dynamo is cast in one solid piece with the base. At a speed of 350 revolutions an electro-motive force of 110 volts is developed.

The lamps used in the steamer's state-rooms, dining-rooms, saloon, etc., are placed upon 10 independent circuits which are controlled from a slate switchboard placed at a convenient point. The various rooms are wired with flexible moulding in which the wire is thoroughly insulated by the moulding itself. The main leads are all lead-covered cable, the junction and cut-out boxes being water tight. The cut-out boxes are lined with asbestos and have glass fronts so that it can be seen when a fuse has been blown out. Wherever it is thought necessary wooden mouldings are backed with asbestos painted with shellac.

In addition to the lights for interior illumination the steamer will be provided with a Huntington search light and equipped with some specially designed cargo lights to be swung from the masts. These will be in the form of 25-light clusters, each lamp being of 32 c. p. This installation is made by Messrs. Seeley & Taylor, 24 Cortlandt street, this city, and the excellence of the details is largely due to their oversight and care. The dynamo was furnished by Mr. Peter Claus, the superintendent and general manager of the Continental Dynamo Company, 63 Broadway, this city.

Arc Welding.

In the few years of its rapid development electric welding and metal working has taken a prominent place in the industrial world. The very ingenious apparatus which is now in considerable use has succeeded admirably in accomplishing many difficult feats in welding and forming various materials. As is now known to every one, the process as generally used simply depends on the heating of the abutting ends of the metal to be welded. By the passage of a current of electricity across the surface of contact, it is done with admirable success and rapidity, but the volume of current required is necessarily very large. The heating is obtained in virtue of quantity of current, and to raise any considerable mass of material to a welding temperature requires an enormous expenditure of electrical energy, lasting, to be sure, only a short time, but, nevertheless, requiring special conditions for its production and utilization. The modern electric welding plant has up to the present required special forms of apparatus, which, however efficient, somewhat limit the applicability of the general processes of the electrical heating of metals to workshops large enough or placed favorably enough to secure the necessary current.

We show herewith some very ingenious modifications of the general idea of electric welding, having for their purpose the reduction of the maximum amount of current required, and, what is no less important, utilizing the heat of electric energy in such a way that welding can be done with ordinary currents from common and readily available machines, so that wherever an arc or incandescent circuit is available welding can be successfully carried on. The various devices are the invention of Mr. C. L. Coffin, of Detroit, Mich., and the fundamental principal on which he has worked may, perhaps, be called that of an electrical blowpipe.

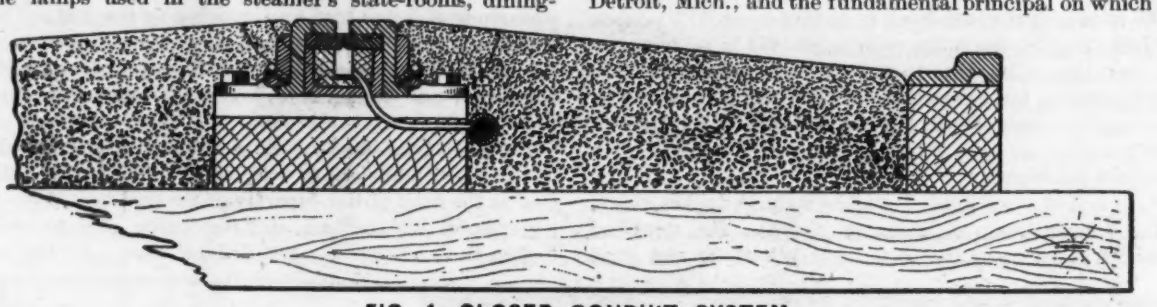
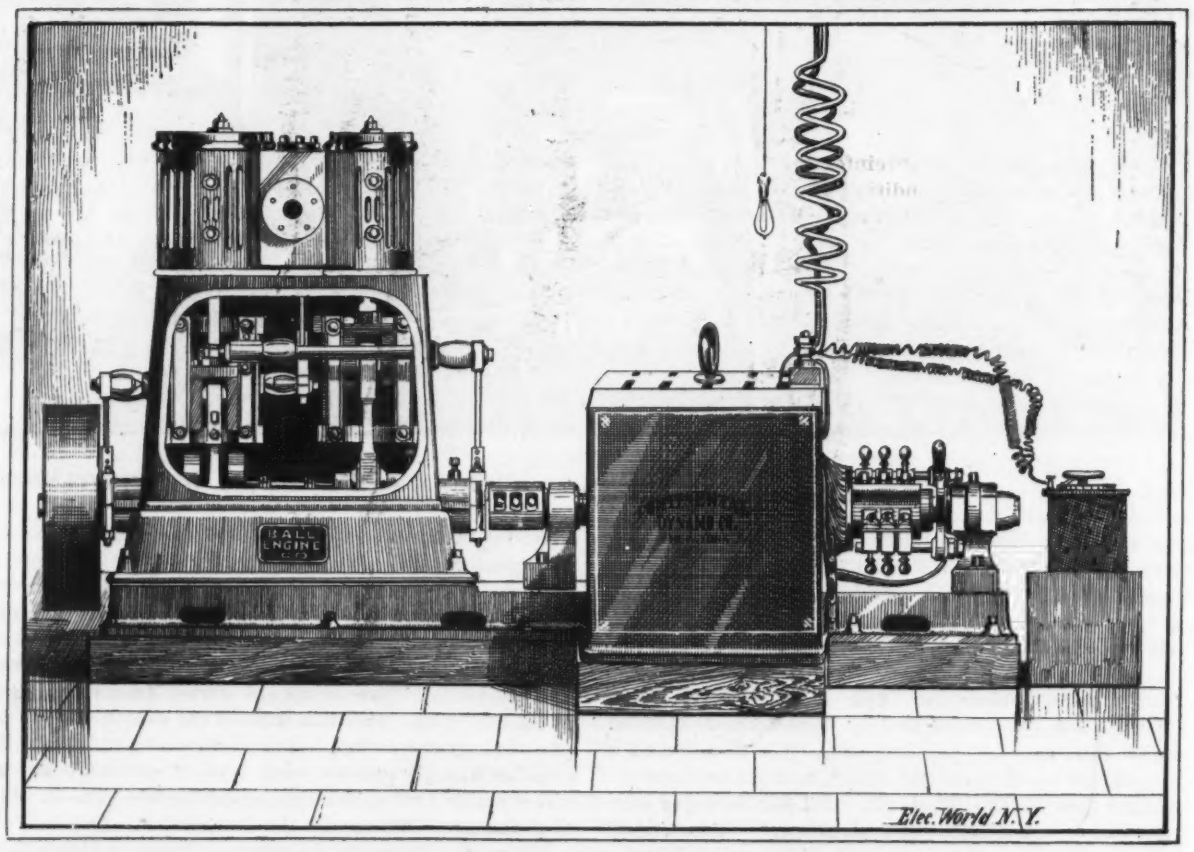


Fig. 1.—Closed Conduit System.

The illustration, Fig. 1, is from a photograph of an arc welder in actual operation. The general principle employed is the heating of the points of contact, or rather heating of the surfaces to be welded, by the application of the electric arc formed between two converging carbon pencils and blown downward like a blowpipe flame by the influence of an electro-magnet. The hoop held in the anvil clutches is subjected at the joint to the intense heat of the arc sprung between the carbons and projected downwards by the magnetic blast. The arc and current regulating mechanism is carried in a box supported by the sliding yoke which is elevated from the arc by the lever shown. The switch at the lower left hand of the figure regulates the intensity of the magnetic blast, thus lengthening or shortening the electrical blowpipe flame, while in addition by raising and lowering the magnetic cores the blast may be regulated within certain limits without employing a switch. The anvil clutches are provided with interchangeable heads adapted to straight, curved and irregular work. The depresser lever also admits of the material being submitted to any desired exposure to the arc at the will of the operator. Fig. 2 shows the simple portable arc welder intended for small work such as may be found in tinshops, plumbers' shops and in light metal work generally. The frame is supported upon insulating rollers, and carries the regulating apparatus. The magnetic blast can be regulated in two ways—by raising or lowering the threaded core, or by a switch. A scale is provided so that a tool may be set for working upon metal of different thicknesses, and this is so calculated that when the index hand is set to a figure denoting the gauge of the material operated upon the best result will be obtained.



Combined Continental Dynamo and Ball Engine.

The great beauty of this arc welding is that it places at the disposal of the operator an enormous temperature which can be applied to just the point desired and all this is available wherever an electric circuit can be obtained. It may be placed on any continuous current circuit, or operated from any dynamo intended for arc or incandescent lighting. Where it is impossible to secure service through a central station a small isolated dynamo may be used. It is almost literally an electrical blowpipe of enormous power

and ready applicability to all sorts of conditions. The expense of installation is comparatively light on account of the simplicity of the apparatus and because no special dynamos have to be installed. The cost of maintenance is something like that of an ordinary arc lamp, of which the ordinary welder is about the equivalent in energy consumed. As it is sometimes necessary to reinforce a weld this contingency has been provided for by

FIG. 1.—COFFIN ARC WELDING MACHINE.

other appliances, whereby the reinforcing material can be supplied in semi-molten condition at the point desired. For special purposes an air blast is sometimes used in connection with a magnetic blast. Of course it should be said that the welding of steel by this process requires some special precautions by reason of the intense heat at hand, but the work can be successfully done, and other metals are as manageable by this as by any process.

The apparatus shown in Fig. 3 is a modified form of welder whereby the material may be heated in three ways, by incandescence as in the common process, the arc, or by both, the material being secured in the clamps as in the

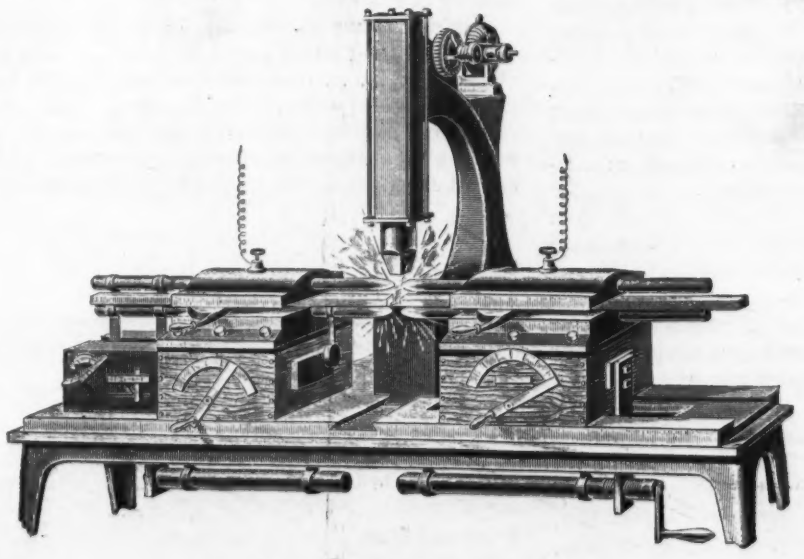


FIG. 3.—AUTOMATIC ARC WELDER.

illustration. The workman turns on the current. The arc is then formed between two pairs of carbons upon each side of the material. It will be seen that the extremity of the metal in this instance is subject to the intense heat of the arc. When the temperature is sufficient for welding, the small switch seen at the left is moved over one point, which throws the carbon and carbon regulating apparatus shown on the left, out of circuit and energizes the electro-magnets contained in the base of the clamp blocks. At the same time the releasing mechanism causes the pairs of carbons to recede, and the magnkts being attracted towards each other draw the material together at a steady uniform pressure which can be regulated to any temperature or degree. The electro-magnet carried on the traveling block to the right is wound in sections or separate bobbins, the terminals of which are connected with the switch points, so that the work can be effected in almost any desired way by the influence of the magnet above it. When sufficient pressure has been applied by moving the small switch one point more, the little motor operating the electric hammer can be put in operation. The anvil block under the material first moves forward, and then the electric hammer is automatically thrown into operation. This may be arranged in various ways. In the machine illustrated the drop is suspended in a solenoid of many spools, and terminals are brought up in a double commutator so arranged that ordinating impulses are given when the contacts are revolved over the face of the commutator. They are so arranged that the force of the blow can be regulated. The speed of the moter can be governed by the switch rheostat shown at the left and carried on to the base of the clamp blocks. When the weld has been sufficiently hammered, the hammer is thrown out of circuit and the anvil thrown back from under the work, cutting out the motor when it reaches its place.

This machine is also arranged so that the carbon may be dispensed with and the arc sprung between the extremities of the material if desired. In this arrangement the magnets are in shunt around the arc so arranged by resistances that when the resistance of the arc and the material by reason of its being highly heated has reached a certain predetermined point the current is shut off. The arc regulating apparatus and the magnets automatically press the weld home, the hammer is thrown into action and the weld applied as before. For very thin material this machine is provided with a cut-out to the arc regulating device, so that the material is heated by the current itself and by the carbons which are brought together and between which the material rests. The whole machine is of a most novel character and is reported to work with beautiful regularity. It is so constructed that the same pressure and amount of hammering can be applied to many thousand welds without variation, thus making it nearly automatic in its operation.

Fig. 4 shows a modification of the incandescent welding process for the purpose of localizing the heat and producing an unusually great electrical resistance at the joint so as to facilitate the initial part of the operation, which often demands a very large amount of current. A resisting body, such as a thin sheet of mica, is temporarily placed between part of the surfaces to be welded and withdrawn when the welding action has been fairly started. In addition, a powerful magnetic field is concentrated around the joint for the purpose of aiding in the same action. It is claimed that the initial demand for current on incandescent welding is considerably reduced by this process, but it is to be regarded as a modification of ordinary incandescent welding rather than a distinctly new operation like the arc welding. It

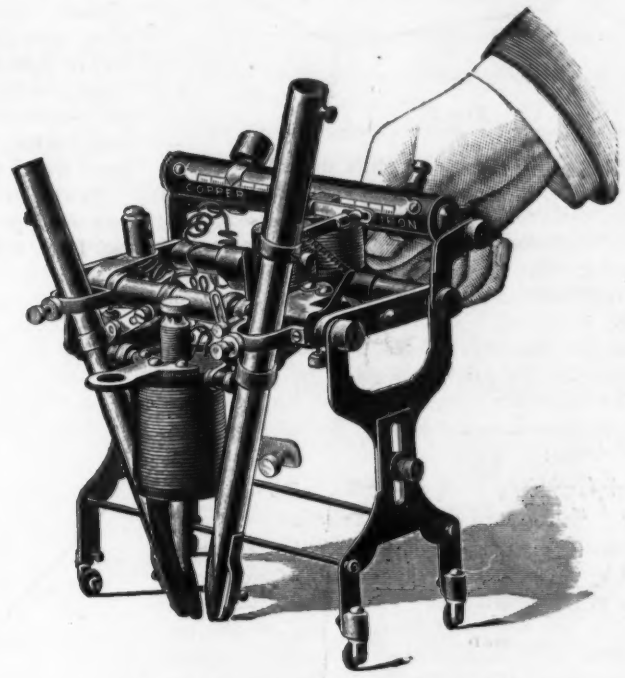


FIG. 2.—PORTABLE ARC WELDER.

seems altogether probable that the arc-welding machine may find a very considerable use, especially as it may be made very small, so that it can be handled with the greatest facility. By no other means known can so enormous a temperature be regulated and adjusted with such facility. Mr. Coffin even proposes to make a very minute arc welder for jewelers' use and the smallest metal work—a little tool that can be handled almost as readily as a pencil. While, of course, unable to cope with large work, it would be exceedingly handy in small operations of metal working.

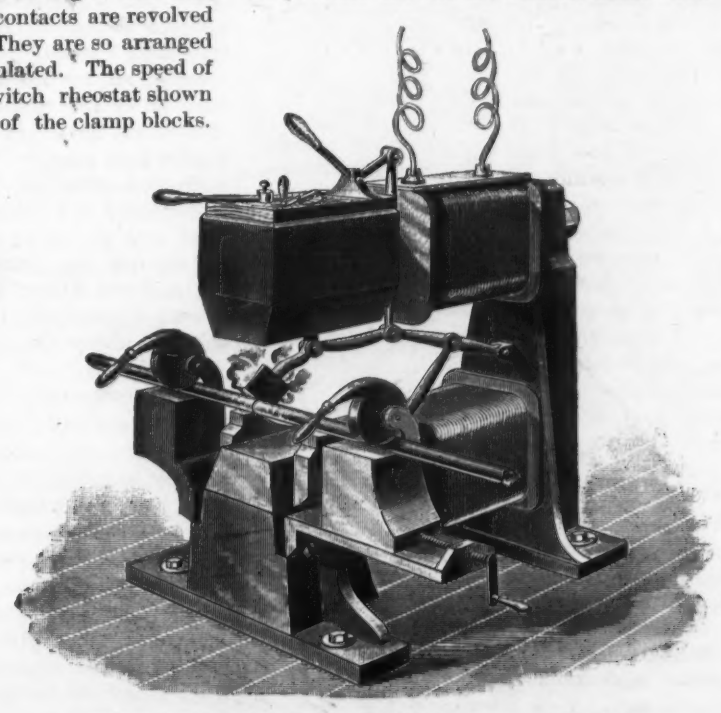


FIG. 4.—IMPROVED INCANDESCENT WELDER.

The whole arc process is for obvious reasons a most convenient one and is as neat theoretically as it is said to be successful in practice. The idea of handling the electric arc as one would a blowpipe, with a magnetic blast instead of air, is certainly a very beautiful and ingenious application of theory, and while the full details of the work done have not been made public the apparatus has been sufficiently tested to show that it possesses very many useful qualities.

On Current Distribution in Networks of Electrical Conductors.

BY J. HERZOG AND L. STARK, Buda-Pesth.

In a previous paper* we communicated a simple method or the predetermination of current distribution in a given network of electrical conductors, consisting, essentially, of the following operations: The network, Fig. 1, is opened or

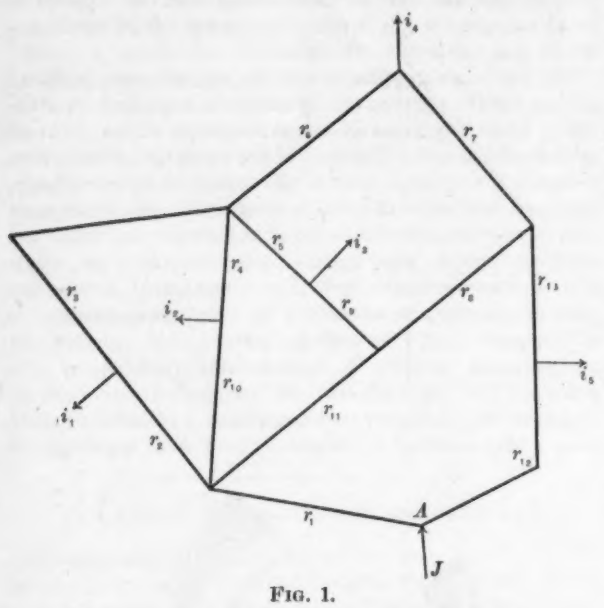


FIG. 1.

cut at suitable branching or nodal points in such a way as to be completely dissolved into open networks, each of which remains, however, in connection with the feeding source, either directly or indirectly. Imagine any conductor cut at a point, where a current i is tapped; the two parts of the conductors, near the cut, will then be passed by currents x_1 and $i-x_1$, respectively. Thus, each cut forms an unknown quantity, and also an equation for the same, expressing that the loss of potential from any feeding point to the cut is the same, whatever way we may choose, from the former to the latter. For the unknown x_4, Fig. 2, we obtain:

$$(i_1 + i_2 + i_3 + i_4 - x_4)\, r_1 + (i_4 + x_2 - x_3 + x_4)\, r_{11} + (i - x_3 + x_4)\, r_3 + x_4\, r_{13} = (i_5 - x_4)\, r_{12}$$

It will be noted that, in these equations, the unknowns are multiplied by coefficients which are linear functions of the resistances of the conductors. Those quantities in the equations which are not coefficients of any of the unknowns are sums of products of known consumed currents into linear functions of the resistances of the conductors. Denoting the coefficients of the unknowns by $(a_{1\,1})$ . . . $(a_{n\,n})$ and those of the consumed currents by $(r_{1\,1})$ . . . $(r_{n\,m})$, these equations may be written as follows:

$$(r_{1\,1})x_1 + (a_{1\,2})x_2 + (a_{1\,3})x_3 + \ldots = (r_{1\,1})i_1 + (r_{1\,2})i_2 + \ldots$$
$$(a_{2\,1})x_1 + (a_{2\,2})x_2 + (a_{2\,3})x_3 + \ldots = (r_{2\,1})i_1 + (r_{2\,2})i_2 + \ldots$$
$$(a_{3\,1})x_1 + (a_{3\,2})x_2 + (a_{3\,3})x_3 + \ldots = (r_{3\,1})i_1 + (r_{3\,2})i_2 + \ldots$$
. . . . . .

Hence

$$x_1 = \begin{vmatrix} [(r_{1\,1})i_1 + (r_{1\,2})i_2 + \ldots], (a_{1\,2}), (a_{1\,3}) \ldots \\ [(r_{2\,1})i_1 + (r_{2\,2})i_2 + \ldots], (a_{2\,2}), (a_{2\,3}) \ldots \\ [(r_{3\,1})i_1 + (r_{3\,2})i_2 + \ldots], (a_{3\,2}), (a_{3\,3}) \ldots \end{vmatrix} : \begin{vmatrix} (a_{1\,1}), (a_{1\,2}), (a_{1\,3}) \ldots \\ (a_{2\,1}), (a_{2\,2}), (a_{2\,3}) \ldots \\ (a_{3\,1}), (a_{3\,2}), (a_{3\,3}) \ldots \end{vmatrix}$$
. . . . . .

Similar expressions result for the other unknowns,

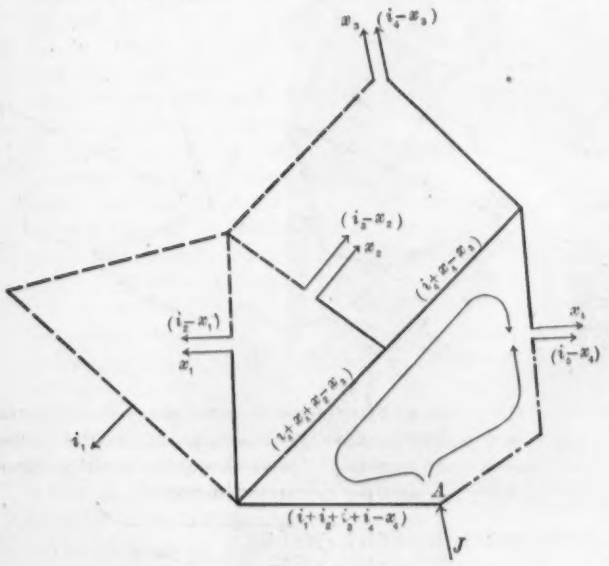


FIG. 2.

differing only in the numerators, the denominators being the same and depending only upon the resistances and the configuration of the network. The determinant forming the numerator may be split up into a sum of determinants:

$$i_1 \begin{vmatrix} (r_{1\,1}), (a_{1\,2}), (a_{1\,3}) \ldots \\ (r_{2\,1}), (a_{2\,2}), (a_{2\,3}) \ldots \\ \ldots\ldots\ldots\ldots \end{vmatrix} + i_2 \begin{vmatrix} (r_{1\,2}), (a_{1\,2}), (a_{1\,3}) \\ (r_{2\,2}), (a_{2\,2}), (a_{2\,3}) \\ \ldots\ldots\ldots \end{vmatrix} + \ldots .$$

or in words: Current x_1 may be viewed as the sum of all the currents produced by gradually tapping in the consumed currents, one by one, all the rest of them being supposed zero. Precisely, this *theorem of the superposition of the consumed currents* may be formulated as follows:

"The current in any branch of a network due to the consumed currents taken off in various branches is the algebraical sum of the currents in that branch due to each consumed current considered separately, all the others being supposed zero."

This rule may also be derived from the well-known theorem of superposition of E. M. F.'s by replacing each current-consuming device of resistance r and current i by a counter E. M. F. : $e = E - i\,r$, E being the E. M. F. of the source.

These two theorems of superposition are nothing but expressions of the fact, evident in the linear character of the equation, that the problem of current distribution is univocal.

The theorem of the superposition of consumed current offers more than a theoretical interest; in fact, it provides a convenient means of solving many questions that arise during the development of a central station.

The network of such a station is chosen for some probable current distribution. This distribution has often to undergo essential variations even during installation; certainly such variations will take place in daily and monthly or seasonal periods. Besides, the development of the central station will also enlarge and displace the currents consumed. Of course the influence of these different variations upon the load on the conductors and the amount of loss of potential could be kept in evidence by setting up a corresponding number of new equations and making tiresome evaluations. But our theorem affords the means of constructing in advance graphical or numerical tables, from which the desired results may be gathered.

At any one of the nodal points of the network, imagine one single derivation equal to any suitably chosen amount, say 1, 10, 100 or 1,000 ampères, all the others being sup-

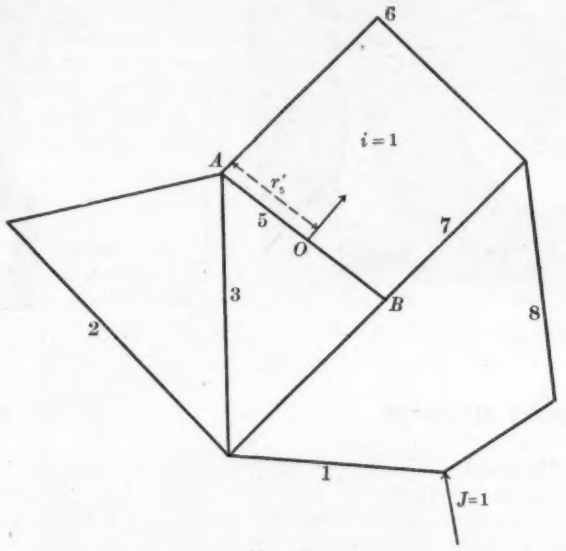


FIG. 3.

posed zero, and for this single consumed current arrange the system of linear equations after having made a suitable number of cuts. Next, place this consumed unit at the next nodal point and let it thus wander through all the nodal points of the system. Then, the number of the resulting systems of equations will equal that of the nodal points of the network, and the current distribution may be determined for each position of the consumed unit. At first glance this seems to be a rather troublesome task; the work is, however, essentially shortened and simplified by the fact that for all unknowns, throughout all systems of equations, the denominator determinant is the same, the numerator for any unknown throughout all the equations having as constituents always the same sub-determinants.

Consider any conductor AB in a network of n conductors with the consumed unit placed at its end A; then there will be n currents, $(x_n)_A$ in the conductors due to this one derivation. Next, imagine this derivation equal to th unit to be taken at the other end, B, of the conductor; then, the n conductors will be passed by n other currents, (x_n). Now, we are enabled to design a graphical scheme for this conductor of the network, containing as horizontal base line the conductor itself on the scale of its resistance, and as ordinates at each end, A or B, all the currents $(x_n)A$ and $(x_n)B$—taken with their signs, respectively.

To discuss the network in Fig. 3 completely, eight tables, one for each conductor, would be necessary. One of them, belonging to conductor 5, is represented by Fig. 4. Here

$$\overline{A1} = (x_1)_A \qquad \overline{B1} = (x_1)_B$$
$$\overline{A2} \qquad\qquad \overline{B2} = (x_2)_B$$
. . . .
$$\overline{A8} = (x_8)_A \qquad \overline{B8} = (x_8)_B$$

Now join the ends $n\,n$ of corresponding ordinates $(x_n)_A$ $(x_n)_B$ by a straight line $n\,n$, and at any point O of $A\,B$ draw a perpendicular upon the base line, intersecting $n\,n$ at N. Then, $O\,N$ is easily shown to be the current in conductor n, due to the current unit being branched off at point M of conductor $A\,B$. To prove this it is only necessary to show that the equation joining x and r' is that of a straight line. Now r' can be contained only in the equations that consider the whole loss of potential e from A to B (Fig. 5). This loss is

$$e = x\,r' - (i - x)(r - r') = i\,r' - i\,r + x\,r,$$

which is the equation of a straight line. In analogy to a similar curve in graphical statics this line may be called the *influence line.*

Imagine the real current supply to be such that at various points of a certain conductor the consumed currents i_1, i_2, i_3 . . . are tapped; at each of these points draw perpendiculars upon the base line and multiply each segment, produced by intersection with the influence line by

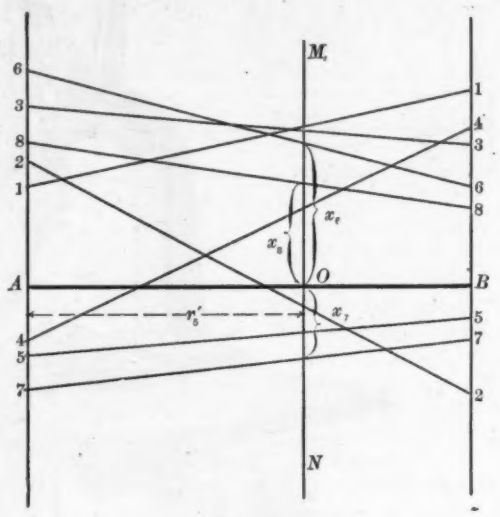


FIG. 4.

its corresponding current, taken in the suitable unit. Add the resulting currents that belong to one and the same conductor and proceed in a similar way with all the other tables. Then, according to the theorem of the superposition of currents, the load on any conductor due to the simultaneous supply of all the current consumers will be obtained by adding all the currents for this conductor gathered from all the tables. Obviously the influence of any additional current consumer can be found out from the tables in a similar way.

In practice we generally have two forms of current supply, viz., for concentrated loads, which act at distinct points, and for distributed ones, which act over a continuous length of the conductor. Reducing corresponding distributed or concentrated loads to one concentrated load simplifies the predetermination of current distribution in a high degree. In fact, *several concentrated loads or a distributed one, between any two neighboring nodal points may be reduced to one concentrated load equal to the algebraical sum of these loads, and tapped from the common centre of gravity.* The current distribution will be the same for the whole network, whether the reduced load or all the loads not reduced are taken into consideration; only the part of the conductor between the first and the last of the loads that have been gathered will not be equally loaded in both cases; it is, however, an easy matter to calculate the real currents for these parts of the conductor, the distribution in the rest of the network being found out beforehand by means of the reduced load.

That the resulting load passes the centre of gravity may be deduced from the analogy between the momentum of a current and a force. Nevertheless we will show the validity of this rule.

Consider, of any network, a conductor AB (Fig. 6) at various points of which currents i_1, i_2, . . . are branched off; let r_1, r_2, . . . denote the resistances of the conductor from it to these points. Put R_1 for the sum of all the resistances that lie between A and the source, and are passed by the sum of the consumed currents, i_1, i_2 + . . . and let R_2 stand for the sum of all the resistances between

FIG. 5.

B and the source. Let V_1 and V_2 be the losses of potential from the source to A and B, respectively, that are due to the rest of the currents in the conductors.

Then,

$$i_1 (r_1 + R_1) + i_2 (r_2 + R_1) + \ldots + x (r' + R_1) + V_1 = = - x (r'' + R_2) + V_2$$

which equation remains unaltered if, instead of

$$i_1 (r_1 + R_1) + i_2 (r_2 + R_1) + \ldots$$

we write $J(\varsigma + R_1)$, where $\varsigma = \dfrac{\Sigma (i\,r)}{\Sigma\, i} = \dfrac{\Sigma (i\,r)}{J}$

No further proof is necessary to show that the same rule may be applied for the reduction of distributed loads; the usual statement of this distributed load per current meter, however, must first be reckoned over into one per current unit of resistance.

*THE ELECTRICAL WORLD, May 3, 1890.

Doubtless it is of the highest importance to know how many equations are necessary; that is, how many cuts are to be made to make the problem determinately soluble. In the following we will show that *it is necessary and sufficient to put down as many equations as there are closed meshes contained in the network.* Consider, as an example, the network in Fig. 7. Cut each of its four meshes at one place, and, to avoid indistinctness, reckon all the currents circulating counter-clockwise round any mesh as positive with regard to this mesh. Then, of course, a current in the boundary conductor between two meshes will have opposite signs with regard to these meshes. For each of the four cuts we can, then, write down an equation expressing that the algebraical sum of all the losses

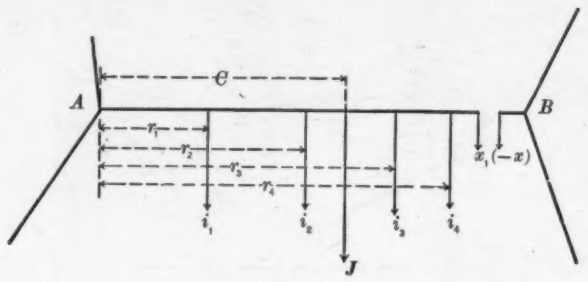


FIG. 6.

of potential taken with their respective signs equals zero. These four equations are:

$$-(i_2-x_1)\,r_4-(i_2+i_3-x_1-x_2+x_3)\,r_3-(i_1+i_2+i_3-x_1-x_2+x_3)\,r_2+x_1\,r_{10}=0 \quad \text{(I)}$$

$$-(i_3-x_2)\,r\ +(i_2-x_1)\,r_4-x_1\,r_{10}+(i_4+x_4-x_3+x_2)\,r_{11}+x_2\,r_9=0 \quad \text{(II)}$$

$$-x_2\,r_9+(i_4+x_4-x_3)\,r_8+(i_4-x_3)\,r_7-x_3\,r_6+(i_3-x_2)\,r_5=0 \quad \text{(III)}$$

$$-x_4\,r_{13}-(i_4+x_4-x_3)\,r_8-(i_4+x_4-x_3+x_2)\,r_{11}-(i_1+i_2+i_3+i_4-x_4)\,r_1+(i_5-x_4)\,r_{12}=0 \quad \text{(IV)}$$

Certainly these four equations suffice to calculate all the unknown currents. From this we may reason that for a network of any number of meshes the number of cuts must equal that of meshes, each mesh containing at least one cut. Cutting the network in Fig. 7 at any one more place r_1, Fig. 8, only apparently alters the number of unknowns, each new unknown y being predeterminated by the former four unknowns.

$$-y=i_2+i_3-x_1-x_2+x_3$$

The theorem of the superposition of currents showed the number and form of the equations to be independent of the number of consumed currents. To discuss the number of equations necessary it is, therefore, sufficient to assume only one consumed current. This simplification will serve to place networks in the form of a more general conception created by Maxwell and published by Prof. J. A. Fleming in a paper read before the Physical Society on June 27, 1885, the knowledge of which we owe to the kindness of the author.

"Consider a network (Fig. 9) containing five meshes or cycles. Now let an E. M. F. act in one branch B and give rise to a distribution of currents in the network. Let $\alpha, \beta, \gamma, \delta$, represent the potentials at the nodal points, and

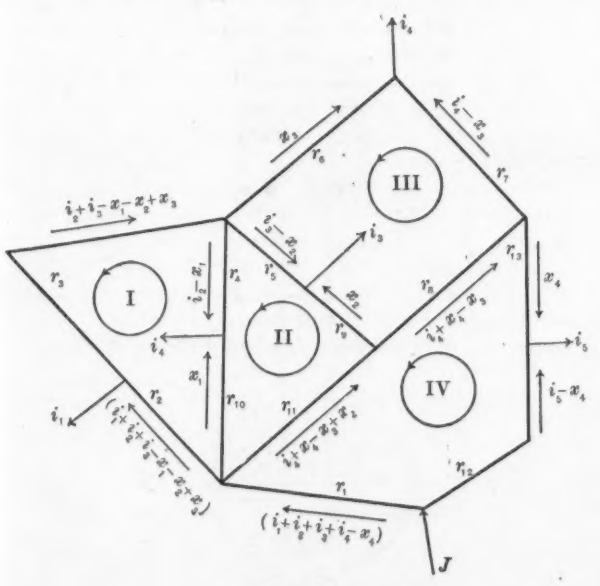


FIG. 7.

A, B, C, D the electrical resistances of the conductors joining these points, and imagine that round each cycle an imaginary current flows, all such currents flowing in the same direction.

"A circuit is considered to be circumnavigated positively when you walk or go round it so as to keep the boundary on your right hand. Hence going round an area A (Fig. 10) in the direction of the arrow is positive as regards the inside if you walk inside the boundary line, and negative as regards external space if you walk in the same direction round the outside. We shall consider a current, then, as positive when it flows round a cycle in the opposite direction to the hands of a watch. The real currents in the conductors are the differences of the imaginary currents in adjacent cycles or meshes.

"Let $x, y, z, \ldots$ denote these imaginary like-directed currents. Then $(x-y)$ denotes the real current in the branch J, and similarly $(x-z)$ that in branch H. Then x, y, z may be called the cyclic symbols of the areas. The cyclic symbol of external space is taken as zero; hence the real current in B is simply x.

"Applying Ohm's law to the cycle x formed by the conductors B, J, H, we have for these three conductors

$$\gamma-\alpha=E-Bx.$$
$$\gamma-\beta=(x-y)\,J.$$
$$\beta-\alpha=(x-z)\,H.$$

"Adding together these three equations, we obtain

$$E=x\,(B+J+H)-y\,J-z\,H.$$

"This equation is called the equation of the x cycle; and we see that it is formed by writing as coefficient of the cyclic symbol x the sum of all the resistances which bound that cycle, and substracting the cyclic symbol of each neighboring cycle multiplied respectively by the common bounding resistance as coefficient, and equating this result to the effective electromotive force acting in the cycle written as positive or negative according as it acts with or against the imaginary current in the cycle. This is Maxwell's Rule."

In this way we can form as many independent linear equations as there are meshes, and therefore unknown cyclic symbols, the real current being differences of these imaginary currents.

From this general network problem it is easy to pass to a more special one dealing with a network for lighting purposes where the current-consuming devices are connected in parallel between two *half-nets.* As we can discuss the equations without dealing with more than one consumed current, we may draw the network of Fig. 1 as is shown by Fig. 11, retaining of the consumed currents only i_4. Consider two half-nets having n meshes each; then there will

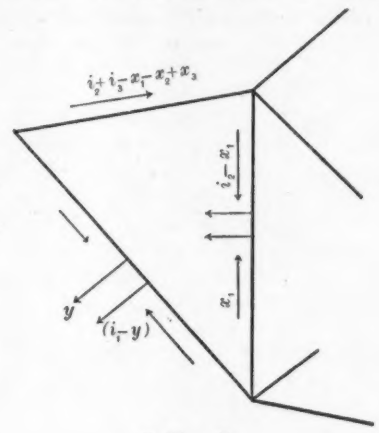


FIG. 8.

be $2n+1$ cycle-currents in total, one of which, namely, that in the cycle of currents consumed, is known. In consequence of the equal configuration of both half-nets the remaining $2n$ unknowns come down in number to n.

For networks of relatively few meshes, the evaluation of n unknown from n linear equations will be conveniently made by means of determinants. The work is greatly shortened by the relatively high number of zeros that ordinarily occur in these determinants. By suitably interchanging some rows or columns it is possible to crowd most of the zeroes in one corner, and then, according to Laplace's rule, the given determinant equals the product of two determinants of lower order.

$$\begin{vmatrix} r_{11} & r_{12} & \cdot & r_{18} & r_{14} & r_{15} \\ r_{21} & r_{22} & \cdot & r_{28} & r_{24} & r_{25} \\ \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\ 0 & 0 & \cdot & r_{33} & r_{34} & r_{35} \\ 0 & 0 & \cdot & r_{43} & r_{44} & r_{45} \\ 0 & 0 & \cdot & r_{53} & r_{54} & r_{55} \end{vmatrix} = \begin{vmatrix} r_{11} & r_{12} \\ r_{21} & r_{22} \end{vmatrix} \times \begin{vmatrix} r_{33} & r_{34} & r_{35} \\ r_{43} & r_{44} & r_{45} \\ r_{53} & r_{54} & r_{55} \end{vmatrix}$$

It may, however, happen that even after this reduction the remaining determinants are of a very high order, requiring, therefore, much work and time for solution. For any determinant of the nth order consists when evaluated of $n!$, *i. e.*, $1.2.3. \ldots (n-1).n$ elements. Considering that, therefore, the work for the evaluation of one unknown will be proportional to $2n!$, we will look out for some shorter and less troublesome method of solution, even if it be only an approximate one. It is an interesting fact that similar requirements have been found in other branches of science as high as 86; Bessel's measurement of degrees required the evaluation of 70, Seidel's series of astro-photometric researches that of 72 unknowns. The latter mathematician invented, for similar reckonings, some approximate methods of evaluations, whose essential features we will give below without entering upon any proof, which may be taken from the original paper.* The equations to be solved are:

$$\left.\begin{aligned} a_1 x+b_1 y+c_1 z+\ldots+n_1=0 \\ a_2 x+b_2 y+c_2 z+\ldots+n_2=0 \\ a_3 x+b_3 y+c_3 z+\ldots+n_3=0 \end{aligned}\right\} \quad \text{(A)}$$

Inserting $a_1^2+a_2^2+\ldots=[aa]$

$a_1 b_1+a_2 b_2+\ldots=[ab]=[ba]$

We can put down the following system of standard equations:

$$\left.\begin{aligned} [aa]\,x+[ab]\,y+[ac]\,z+\ldots+[an]=0 \\ [ab]\,x+[bb]\,y+[bc]\,z+\ldots+[bn]=0 \\ [ac]\,x+[bc]\,y+[cc]\,z+\ldots+[cn]=0 \end{aligned}\right\} \quad \text{(B)}$$

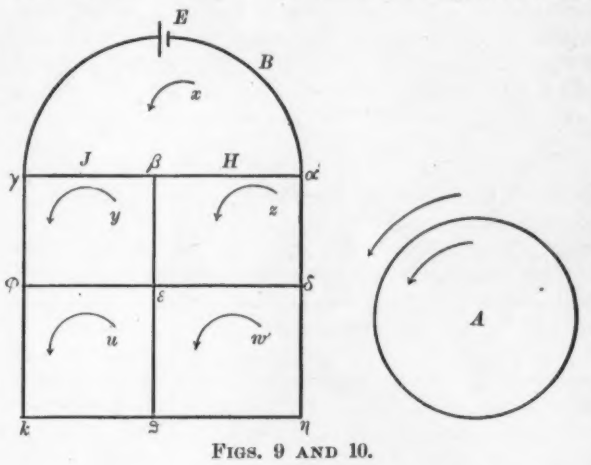
* Ludwig Seidel, Abhandlung der Math. phys. Classe der Bayer Akademie 11. Bd. 1874.

From these equations the unknowns may be found as follows. Assuming any system of numerical values for the unknowns, $x, y, z, \ldots$ they will, of course, not fulfill the standard equations, but will make

$$[aa]\,x+[ab]\,y+[ac]\,z+\ldots+[an]=N_1$$
$$[ab]\,x+[bb]\,y+[bc]\,z+\ldots+[bn]=N_2$$
$$[ac]\,x+[bc]\,y+[cc]\,z+\ldots+[cn]=N_3$$
$$\ldots\ldots\ldots\ldots\ldots\ldots\ldots$$

Now we can improve the value of one of the unknowns, for instance x, changing it by $\Delta x=-\dfrac{N_1}{[aa]}$

This will make $N_1'=0$. And the improved value



FIGS. 9 AND 10.

$x+\Delta x$ will now be such a value of the first unknown as to suit best the preliminarily chosen values of the other unknowns; it would be the most plausible value if the rest of the preliminary values were right.

The variation of x, which changes N_1 into $N_1'=0$, has also an influence upon $N_2, N_3 \ldots$

$$N_2'=N_2+[ab].\ \Delta x$$
$$N_3'=N_3+[ac].\ \Delta x$$
$$\ldots\ldots\ldots$$

Now, we can correct y by adding $\Delta y=-\dfrac{N_1'}{[bb]}$

Instead of $N_1'=0, N_2' N_3' \ldots$ we will then have

$$N_1''=N_1'+[ab]\Delta y=0$$
$$N_2''=N_2'+[bb]\,\Delta y$$
$$N_3''=N_3'+[bc]\,\Delta y$$
$$\ldots\ldots\ldots$$

As a third correction we might change Z, by a value making the new value $Z+\Delta Z$ suit as well as possible the system which is formed by $x+\Delta x, y+\Delta y$, and the preliminary values of the remaining unknowns. We would then obtain $N_3'''=0$. Just as well, however, we might return to x, changing it by $-\dfrac{N''}{[aa]}$ thus making $N_1'''=0$.

As soon as these corrections of any unknown are made in such a way as to fufill that standard equation, in which the unknown in question occupies the favorite position in the *diagonal* of the system of equations, we must obtain a converging approximation toward the real values, no matter in which order these corrections are performed. The corrections are repeated until all the N's are brought upon infinitely small values.

Obviously, the time required for total solution is the less the nearer the assumed values are to the real ones. This is a great advantage of the method for the purpose of

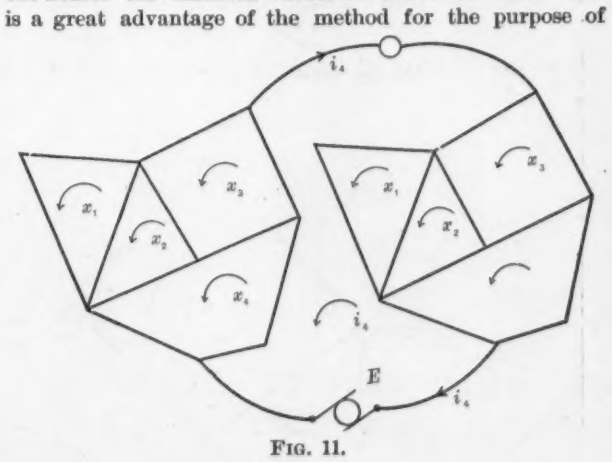


FIG. 11.

evaluating current distribution in networks, as with some practice it is easy to make good assumptions for the values of the unknown currents by considering the configuration of the network and the consumed currents.

The Lyons Exposition of 1892.

The importance attached by all classes and interests to the developments of electrical industry is strikingly shown by the fact that at the National and Colonial Exposition to be held at Lyons, France (the centre of silk manufacture), only two sections will be open to international exhibits, and these two are electricity and silk. This exhibition, while a small affair compared with the plans maturing in Chicago, will undoubtedly be of considerable importance to the French, and Americans should make a good showing. Intending exhibitors can address Henri Martin, Rue de la Republique, 26, Lyons, France.

New Mining Machinery.

Mr. Forée Bain has recently patented a system of mining coal by electrically operated machinery, which consists of an undercutting machine, an overhead drill (for drilling a hole in which to place the blast at the same time the undercut is made, and operated simultaneously by the same motor), an electric trolley device for mining locomotives, and a mining locomotive. These patents have just been issued, and were shown in THE ELECTRICAL WORLD last week.

The undercutting machine is made in two principal parts: the outside frame, to which traction wheels are removably attached, and the inner frame which telescopes within the outer frame. The inner frame carries the motor and the drills. There are thirteen drill rods placed parallel and in front of the motor, every alternate drill rod carrying a special steel conveyor, stamped from sheet steel, and firmly secured to the rod. The object of the conveyors is to remove the cuttings from the drills while the slot is being cut into the coal. The drills or cutting bits are removably attached to these drill rods at their extreme forward ends in such manner that they overlap each other in their rotation to cut through intersecting planes. The drills are grooved together near their rear ends to rotate alternately in opposite directions. By this arrangement it will be seen that a continuous slot, penetrating in most cases 6 feet, can be cut with rotary cutters, without interference of the cutters with each other, their relative direction of rotation being such that should one cutter for any reason tend to lag in its work it would be assisted by those on either side of it. The motor, which is mounted on the inner frame, and which rotates the cutting bits, also supplies the power which gives the system a reciprocating motion to feed into the coal. A clutch immediately in front of the motor connects it with the driving and cutting mechanism, and another located under and at the rear of the motor, withdraws the system after the slot has been cut. After the cut has been made, the machine is shifted, and another cut parallel with the first is made in the same manner, and so on until the room has been finished. When it is desired to move the machine to another location or room, it must be slightly raised and traction wheels put onto the studs. The cutting mechanism may then be disconnected by use of the front clutch lever, and the machine becomes self-propelling, and will move itself around on the floor of the mine or the tracks in the entries. For long distances it may be supplied with the trolley device, and may be used as an electric locomotive for drawing a small number of cars. The machine in good coal will cut a slot three feet wide, four inches high and six feet under within three minutes. It is operated by a specially constructed motor of only six h. p. All of Mr. Bain's electric mining machinery is operated at 225 volts.

The Passaic Shops of the Okonite Company.

The recent organization of the International Okonite Company and its purchase of the interests of the Okonite Company of this country, and of Messrs. Shaw & Connelly, Passaic, N. J., and passes into the hands of the International Okonite Company, a model plant of its kind. It will not be long before Okonite will be manufactured abroad; in fact this will be done as soon as the necessary machinery and appliances are installed. The recent consolidation, if it may be so called, will doubtless prove a profitable business, and bring Okonite within the reach of all in every section of the civilized world.

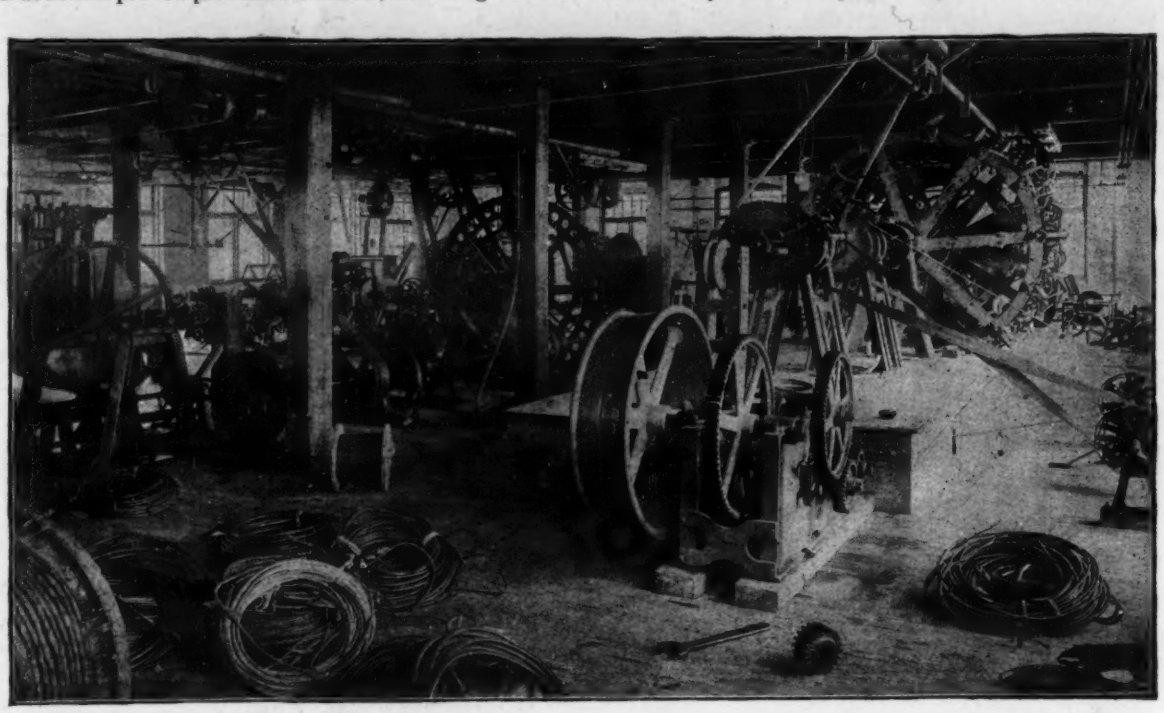


FIG. 1.—CABLING AND ARMORING MACHINES OF THE OKONITE COMPANY.

Through the courtesy of Capt. Willard L. Candee, one of the directors in America of the International Okonite Company, we are enabled to present in this issue some views of the company's new works at Passaic. The factory is a three-story brick building, 380 × 60 feet, with wing 50 × 120 feet, and engine and boiler room 80 × 50 feet adjoining. There are also carpenter, machine and blacksmith shops on the premises. The entire group of buildings and plant covers an area of about six acres. Four hundred hands or more are employed, turning out about 60 miles of insulated wire per day. Water power is used for driving the machinery, furnished by the Dundee Canal on which the factory is situated; but in case this should not be available from any cause an engine of 250 h. p. capacity proves an efficient substitute. In the engine-room is also a 50 horse power dynamo, used in connection with incandescent lights with which the factory is equipped. The establishment is under the supervision of F. Cazenove Jones, superintendent, with Chris. Klotzbach as his assistant.

Of our illustrations Fig. 1 shows the cabling and armoring machines. The cabling machine has been brought to a high state of simplicity and efficiency by Superintendent Jones, and resembles very little the original machine used for this purpose. By a rotating movement it combines any number of wires into a solid well insulated cable. If this cable is intended for submarine use, it passes to the armoring machine, where it is armored and so finished. Fig. 2 will give the reader a good idea of the appearance of the testing room. Here one electrical expert and four assistants are continually at work testing all okonite wire, by the aid of very fine Thomson galvanometers, before it is shipped from the factory.

FIG. 2.—TESTING ROOM OF THE OKONITE COMPANY, PASSAIC, N. J.

The growth of the Okonite Company, and the demand for its product, have certainly been remarkable, even in this age of astonishing development in the industries that cluster around the generation and distribution of electrical energy; but its shrewd managers believe that their field is but half occupied, and intend to push their way on both sides of the Atlantic.

extensive wire manufacturers at Manchester, England, marks another step forward in the enlargement of the career of okonite. The history of this enterprising concern has several times been brought to the notice of our readers, and it is unnecessary, therefore, for us to refer to it at length.

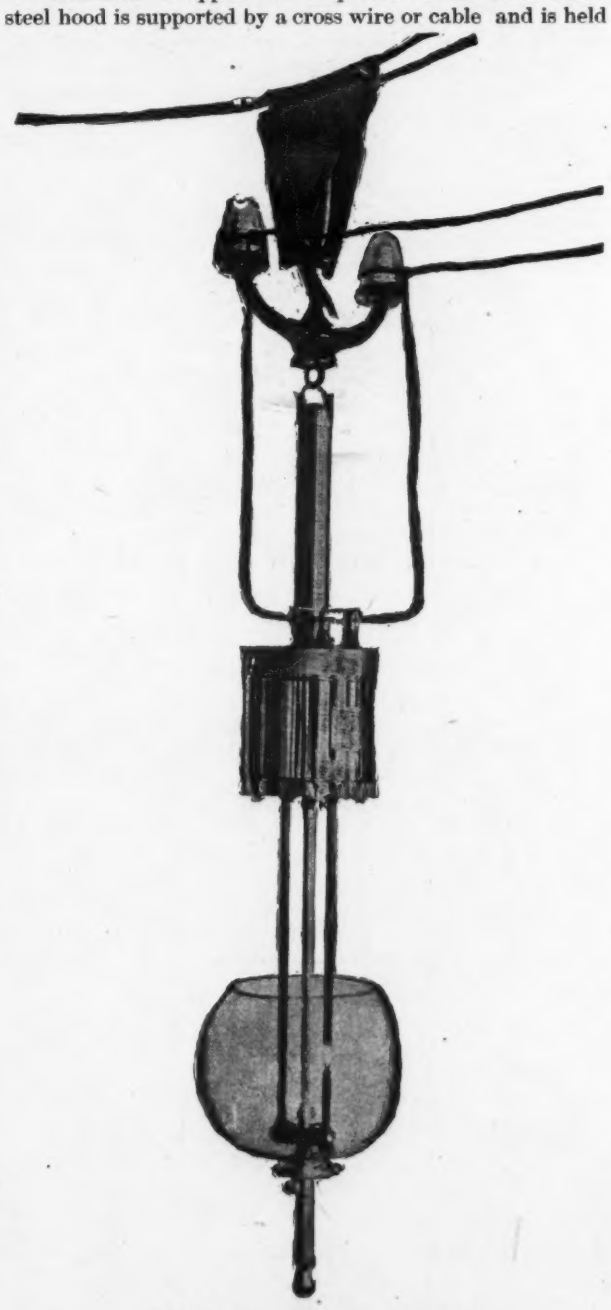
The new company has found, as did its predecessors, that the demand for this insulating compound has far exceeded the manufacturer's facilities for its production. Some months ago the Okonite Company began work on a new factory, which is now completed and is very commodious. It is located, as was the former establishment, at

A Hanger for Electric Lamps.

The accompanying illustration shows a new style of suspension for electric lamps. It is intended for use with any system of electric lighting, either arc or incandescent, and in all places where it is necessary or desirable to lower the lamps for the purpose of changing, renewing or trimming. It is manufactured and put upon the market by the Forest City Electric Works, Geneva, Ohio.

The lamp is entirely supported by the hook on the line wire supporting the frame, which engages with a steel pin in the hood, thus taking all strain off the raising and lowering cord. This cord is not in use except when raising or lowering, and will, it is stated, last much longer than when used to support the lamp. Cutting or untying this cord maliciously cannot drop the lamp, as to disengage it from the hood the lamp must be raised about six inches by the cord.

When used to support the lamp over the street the sheet steel hood is supported by a cross wire or cable and is held



NEW HANGER FOR ARC LAMPS.

in position by a small wire or cord running to the pole. This allows of readily placing the lamp at any point over the street, and if it is desired to trim the lamp at one side of the street as in case of wires interfering, the position cord can be released and the raising and lowering cord will draw the entire hanger to one side of the street and release the lamp. This will then come straight down, and when trimmed can be pulled into engagement with the hood, and the entire hanger, with the lamp, is then drawn along the cross wire to the proper position over the street.

The advantages claimed for this style of hanger are that the lamps when in position are supported entirely by the

cross wire or cable ; that the cord is in use only when raising or lowering the lamp ; that the lamp is insulated from the hanger ; that there is no strain on the lamp connection; that there is no danger of the lamp dropping by breaking or cutting of the cord; and that it is easily operated.

A New Wall Bracket.

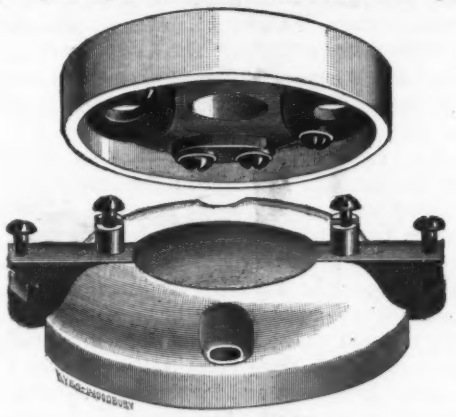
The same steady demand for higher insulation, which has led to the production of good weather-proof wires, has also resulted in bringing out a finer quality of insulators

THE SPRINGFIELD BRACKET.

and better means of supporting them. The latest of these improved supporting devices, shown in the accompanying cut, is called the "Springfield Bracket" and is manufactured by the Great Western Electric Supply Company. Being made of malleable iron with a ribbed arm and a hollow screw, it is very light, strong and tough. The split screw has a slight give to it and grips the insulator tightly. The wall plate is also novel in design, being so shaped as to give a large spread with very little metal. The makers have in preparation other forms of malleable iron brackets embodying the same good features as this one.

New Rosette Cut-Out.

The accompanying cut illustrates a porcelain rosette cut-out, just placed on the market, containing several new features, especially in the manner of disconnecting the cap

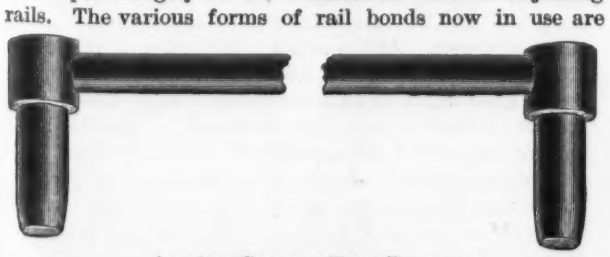


BRYANT CUT-OUT.

from the base. The cap is detached by inserting a screwdriver in the hole recessed for that purpose in the cap and loosening the screw one or two turns. It is then easily removed, allowing the fuses to be inserted while out of contact with the circuit. The parts are few and simple, having firm electrical contact and no parts to work loose. The Bryant Electric Company, of Bridgeport, Conn., are manufacturing this cut-out among their other specialties.

An All-Copper Rail Bond.

In electric railways with overhead wires the resistance of the ground return, and the consequent loss of energy, will depend largely on the connection between adjoining rails. The various forms of rail bonds now in use are



AN ALL-COPPER RAIL-BOND.

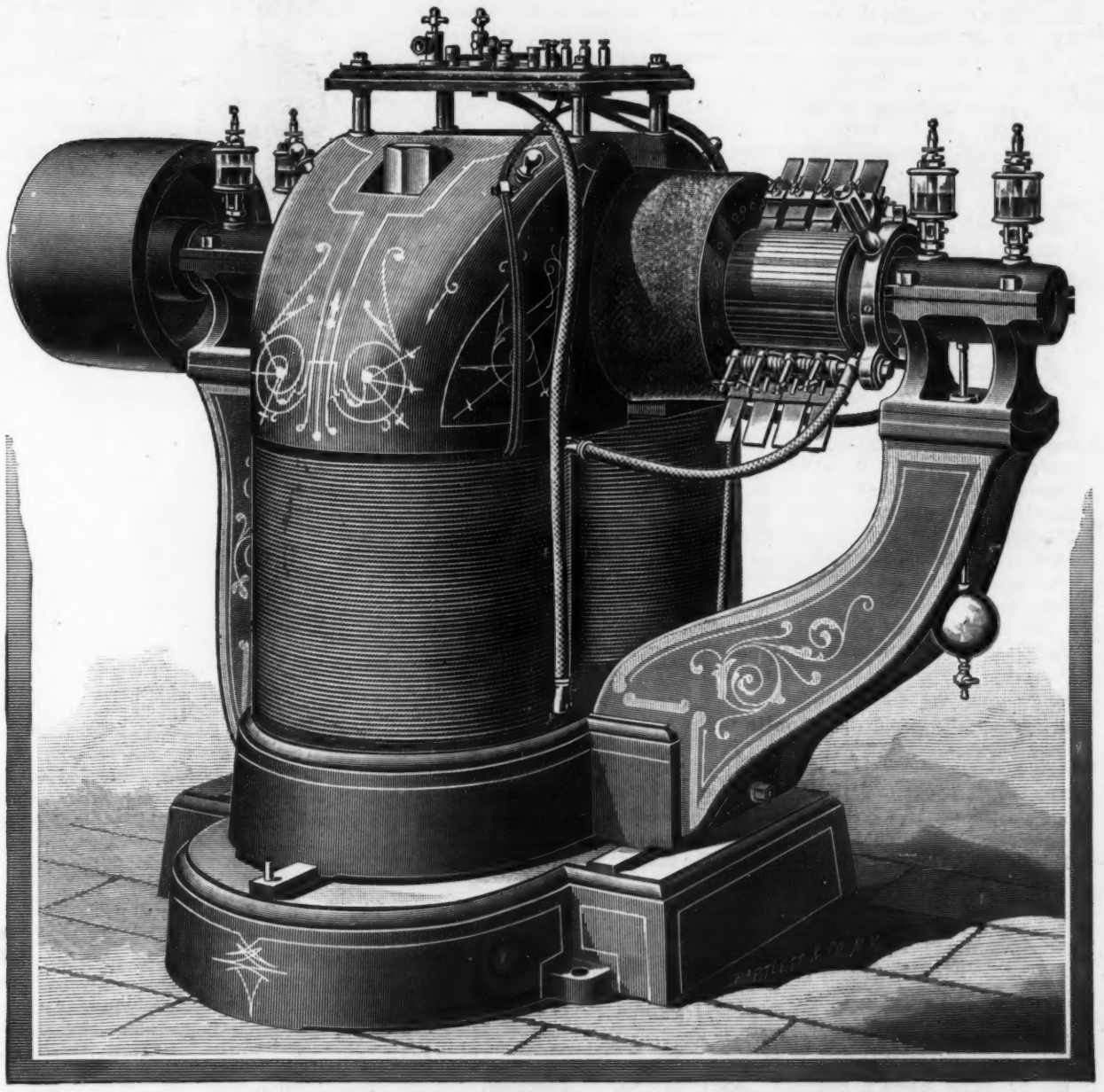
made wholly or in part of iron, and still leave better conductivity to be desired. To fill this want, the Great Western Electric Supply Company is making a rail bond entirely of copper. The cut shows the two end pieces and part of the connecting wire, full size. The taper pieces fit into holes drilled in the rails, and when upset in place they form a good metallic connection. The connecting piece can be made of any desired diameter and length to suit different circumstances, and can be bent to meet any unusual change. This rail bond does away with the brass and iron pieces formerly used, and should give a joint of practically no resistance.

The "National" Incandescent Dynamo.

Among the incandescent dynamos recently placed upon the market, the machine illustrated on this page takes a prominent position in the direct current lighting field. This machine is built by the National Electric Manufacturing Company, of Eau Claire, Wis., and is claimed to possess distinctive features of merit. In producing this dynamo the manufacturers did not attempt to get up a distinctly new type of dynamo, but their aim was to take a well known type and build it as nearly perfect, mechanically, as such a machine could be made.

The field is of the familiar two-pole type, embracing a Siemens armature, wound in a peculiar manner by which the amount of dead wire at the ends of the armature is said to have been materially reduced, making the shaft correspondingly shorter, and insuring rigidity and freedom from vibration. The commutator is made of tempered copper, and presents ample bearing surface to the brushes, which, by their freedom from sparking, practically overcome the objection usually raised against the use of commutator and brushes in this form of apparatus.

One of the most noticeable features of the machine is the small size as compared to its output, showing that the electrical determinations have been made in a very careful manner. The machines are all compounded for a potential of 100 volts, unless otherwise ordered. At the tests of a 500-light dynamo recently completed the load of the machine was changed from full to no load, showing a scarcely noticeable movement of the voltmeter needle.



NATIONAL INCANDESCENT DYNAMO.

The Springfield Electric Light and Power Plant.

The building of the Springfield (Ill.) Electric Light and Power Company was erected in 1889 especially for an electric light station, and occupies the corner upon which stood the old station that supplied the city with arc lights for so many years. The new building was built over the old one, and the lights transferred from one to the other system without a single shut-down. The building is of pressed brick, with brown sandstone trimmings, and the front of the dynamo room is of glass, making a very light and desirable room for the electric plant.

The upper story has the superintendent's office, directors room, a store room and a repair room, containing lathe and other machinery run by a motor. The dynamo room, which is 80 by 54 feet and on the ground floor, is finished in hard pine and the floor is tiled, with a raised pine floor around the dynamos and switch boards.

The boiler room is 100 by 34 feet and contains four 75 h. p. boilers and three 125 h. p. boilers. The coal is brought in from the street on an elevated railway and dumped in front of the boilers. There are six 125 h. p. Ideal engines arranged in the middle of the dynamo and engine room, and the dynamos and generators are on the outside, giving good locations for the switch boards and dynamos and plenty of light and air. There are two foundations for engines unoccupied at present, upon which the company proposes to place Ideal compound engines as soon as more power is needed.

There are five 50-arc light Thomson-Houston dynamos, and two 500-light alternating incandescent dynamos, one of which is used for lighting the streets and alleys of the city and the other for commercial lights. The company is also running one 50 h. p. Royal generator for the motor circuit. There are also two 70,000-watt generators of the Thomson-Houston make for running the electric railway. Each of these is run by an Ideal engine, and when the amperes vary from 5 to 150 there is less than one per cent. variation in the speed of the engine, so that the electric railway is giving excellent service.

The switch boards, of which there are five, are of elegant design, and are probably as fine as anything of the kind in the country. The building is fitted with fire apparatus, and in one minute's time a pressure of 100 pounds of water can be given at five different fire-plugs which are attached to hose.

The ventilation for the dynamos is secured by an underground sewer pipe laid in cement, with radial pipes fitted with air valves directly into the ends of the dynamos. The main pipe, which is eight inches in diameter, is filled with air by a Sturtevant blower, which is run by a motor on the arc circuit. The air pipes running to each dynamo are four inches in diameter, and do good service by keeping the dynamos cool even in the hottest weather.

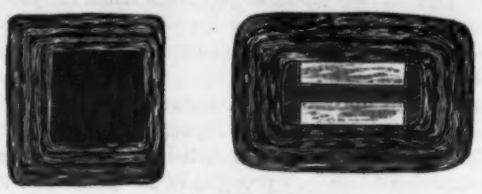
A Fine Field for Inventors.

A correspondent writing from Sydney, New South Wales, says: "We regret to say that we do not know of a single instance where electric sheep-shearing machines are in actual use in Australia; there was no electrical machine on show at the great contest which has just terminated. At this, we may mention, the engineering judges expressed an opinion that they considered compressed air-driven machines superior to those which are direct driven. Despite this, however, the "Silver" direct-driven machine has in actual back block work proved itself very efficient. We believe that there is a great future for electric shearing machines, but as yet we know of none that can pretend to fulfill the many conditions which a successful machine must embody. The great flexibility of the air tube as compared with the metallic flexible direct-driven shafts is one of the best arguments in favor of pneumatic machines; while the necessarily clumsy shape which the employment of a cylinder necessitates is one of the chief objections to their use. You might suggest to some of your people the advisability of experimenting in this line."

A New Packing.

What the mill owner wants in the way of packing is a flexible, durable and soft elastic packing which, by reason of its elasticity, will keep tight without friction. Long experiment seems to have demonstrated that flax makes the best covering for the reason that it holds the dampness better than any other fabric; it thus makes a better lubricator, and for the same reason it is not nearly so liable to burn or char, nor does it become hard or rigid under the action of heat.

Several good features are said to be embodied in the "Sensible Automatic" packing, illustrated herewith, which



A New Packing.

is manufactured by the Automatic Packing Company, at 63 South Canal street, Chicago. This packing is called "automatic" for the reason that while it decreases in size in one direction under the pressure it is free to expand in the other under the action of the heat, or, in other words, it does its own work automatically. The core of the packing is made of red or white gum, which is covered with a series of braids of flax which hold the moisture thoroughly.

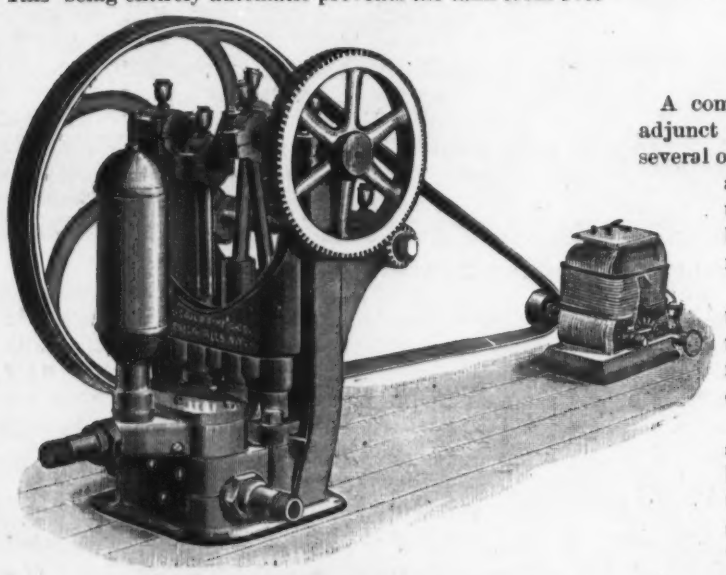
The lubricant is composed of Japanese wax, which is not affected by alkalies or acids, and these features are essential to paper and pulp mills and for the engines and pumps used in such structures. For these reasons the "Sensible Automatic" packing is said to be one of the very best steam and hydraulic packings made. It is placed on the market in the usual sizes, ranging from one-quarter inch upward.

The Gould Type of Electric Pump.

Of the desirability of the electric motor for pumping, and especially of its advantages over other methods of house pumping, The Electrical World has had frequent occasion to speak. There can be no comparison between the older forms of "tank-filling" and the noiseless, cheap, effective and self-regulating motor pump that occupies a corner in the cellar, takes the power of a single incandescent light, and for a dollar a month keeps the tank on the roof filled to the brim every day in the year.

The special design of pump illustrated on this page is that placed on the market by the Goulds Manufacturing Company, of Seneca Falls, N. Y., and No. 60 Barclay street, New York City, and is of ½ h. p. It is capable of lifting 1,000 gallons of water per day a height of 100 feet, or other quantities a correspondingly greater or less height.

By an automatic attachment to the ordinary float in the tank the electricity is shut off as often as the tank is filled, and started again when partially empty, thereby saving the expense of current supply when water is not drawn. This being entirely automatic prevents the tank from ever



Gould Pump Belted to Perret Motor.

becoming entirely empty, and at the same time uses no more current than is required.

The pump is the new type of triple acting suction and force pump especially designed for use with high speed electric motors for continuons pumping service or raising water to considerable heights through pipes. As indicated by its name, it has three pistons driven from one crank shaft, which has the effect of raising the water in a steady and uniform volume, with entire absence of that pounding or "water hammer" so disagreeable to the ear and destructive to plumbing.

The motor shown, as our readers will readily perceive, is the well-known Perret, made by the Elektron Manufacturing Company, of Brooklyn, N. Y., but the pumps can be adapted to any of the usual makes of motor. In the larger sizes, used for heavy pumping in mills and factories, for elevator purposes, and so forth, the motor is usually geared to the pump. The spur and pinion gear used are rendered noiseless by the latter being of rawhide. Slow-speed motors are also sometimes geared directly to the pump, dispensing with belting.

A Pendant Block for Incandescent Lights.

The usual device adopted for regulating the height of hanging incandescent lamps, a bend in the suspending cord and a compensating ball weight, while eminently simple and effective, is still open to objections, and may without doubt be considered somewhat primitive. The block illustrated herewith is an improvement patented and manufactured by the McCreary Electrical Specialty Company, of 18 and 20 Cortlandt street, New York City, which embraces a receptacle for the lamp socket, with means for removing or inspecting it (as shown by the lower dotted lines) and a frictional channel for the passage of the suspension cord or conductor. There is also, of course, a holder for receiving and retaining a shade or reflector.

In addition to its main advantages, the device seems

McCreary Lamp Pendant.

valuable on account of the protection afforded to the lamp socket, which is saved the constant handling that tends to cause it to become loose and liable to short circuits.

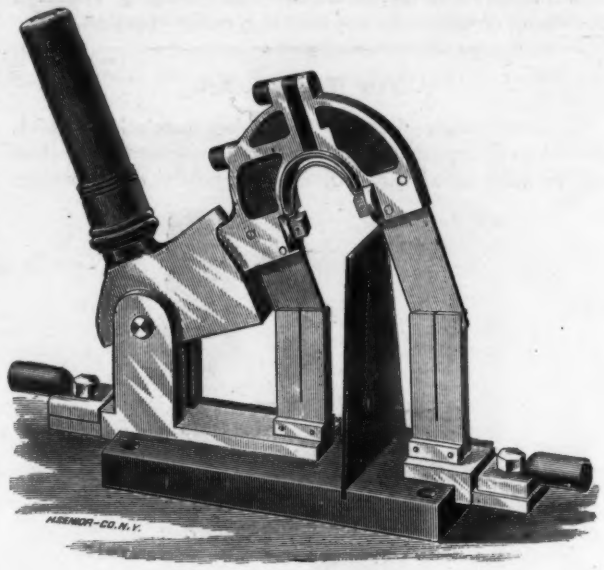
The "Ajax" Switch-Cut-Out.

A compact and efficient switch-cut-out is an important adjunct to a central station outfit, especially so where several of these are to be used on a switchboard of limited area. Usually, a piece of apparatus which occupies the smallest space on the station wall or switchboard has the preference over others, even if it is more bulky in a plane perpendicular to the wall.

Where fusible strips have been used in connection with switches, the custom has been to extend the switch base to accommodate the cut-out; or, in other words, to mount two pieces of apparatus on one base.

In the accompanying cut is presented a novel switch cut-out for 500 volts, in which the copper blades perform a dual service, as terminals for the possible safety strip and contact blades for the switch. The switch, it will be notlced, is of the "Ajax" type, with the curved tongue in a vertical plane, which offers an advantage over the horizontal pattern for use on feeders where several are to be used. Twelve 200-ampère switches, as shown, occupy but 42 inches of space, and the connections are at top and bottom as is generally required of a feeder switch.

This switch-cut-out is compact in design, mechanically well built, and is an important addition to the line of switches manufactured by C. S. Van Nuis, of 74 Cortlandt St., this city. The upper blades are electrically disconnected by a strip of insulation inserted between the two parts of the curved cast tongue which supports them. The lower, or concave surface of the tongue is lined with a thin sheet of insulation, which projects well beyond its edges and prevents the formation of an arc between adjacent metallic parts when the fuse strip melts. The fuse is inserted while the switch is open, and consequently out of circuit, and is secured to the copper terminals by stout cap screws and washers. The fuse wire should be long enough to form a curve, which will pass over the top of the vertical screen which rises between and above the copper contact clips. The insulating screen does



The Ajax Switch Cut-Out.

double duty also in preventing the formation of an arc when the circuit is opened by hand or automatically by the safety fuse.

Electrical Distribution by Transformers from Central and Eccentric Stations.*

BY DR. J. A. FLEMING, M. A.

§ 7. *Cables at Rome.*—The current supplied by these machines is conveyed into three main conductors, often called the feeders. These consist of concentric cable made by Siemens & Halske, laid in wooden boxes filled in with cement and placed underground.† The construction of this conductor well known. It consists of a core of stranded copper wires, covered with an layer of jute impregnated with highly insulating material. Outside this is stranded the return conduetor of copper wires inclosing the core, as in a tube; then more insulation, and finally a double twist of iron or steel tape and hemp protection over that. In Rome there are some 18 to 20 kilometres, or about 12 miles, of this main cable laid up to the present (1890). The cross section of each conductor is 220 square millimetres, or about one-third of a square inch. The main cables are laid in 100 metre lengths, with junction-boxes at this distance.

The three main cables all run together to the Piazza Venezia and then diverge off in different directions, the most distant point reached being about 4½ kilometres, or three miles, from the station. The distance from the station to the point of divergence is about 1,600 metres, or one mile. The mode of making the junctions of the different lengths of the cables and of the branches has been most carefully thought out. The junctions are made in cast iron boxes, in which these junctions are formed by copper straps, links, or clamps, and involve no soldering in making the joint in the street. The lids of the boxes are closed water-tight, and the box then pumped full of rosin oil. The diagrams in Figs. 21, 22, 23 and 24 show the various forms of junction box and mode of making the joint.

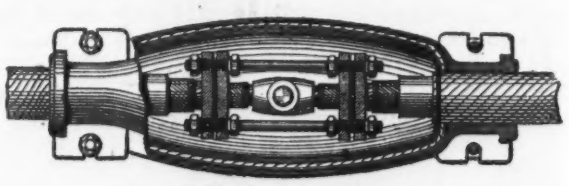


Fig. 21.—Straight-Joint Coupling.

Beyond the Piazza Venezia the three mains give off branches in different directions, smaller concentric cable being used and the sub-mains run to the different groups of transformers, At the present date (1890) there are some 125 transformers installed, all being of the same uniform size of 7,500 watts, or 10 horse-power. These transformers are put in singly or in groups arranged in parallel in the various houses and public buildings, and feed about 12,000 100-volt incandescence lamps of 16 candle-power, 10 candle-power, and 32 candle-power, as well as some 300 Ganz alternating arc lamps of 8, 16, and 32 ampères, which are worked off the immediate terminals of the transformer. The transformers are placed in small fire-proof safes, boxes, or chambers, according to their number, and great pains are taken with the insulation of the primary wires. Bare copper rod is most used for connections and is carefully carried on porcelain insulators, in the transformer rooms where it is possible to do so; in other places highly insulated wire. The transformers each take at full load about four ampères of primary current at 2,000 volts, and give out 75 ampères at 110 volts; the intermediate

* Continued from The Electrical World, Aug. 16, 1890.

† This plan of laying in cement has not been found to be satisfactory. In future it is probable the concentric cable will be laid in wooden troughing filled in with pitch or asphalt.

terminal enabling arc lamps with resistances in series to be put on at 55 volts. A number of 10 h. p. transformers banked together is used in each of the large buildings lit. The lighting comprises not only street arc lighting, but lighting by arc and incandescent entirely of theatres, Senate and Chamber of Deputies, post, telegraph and public offices, besides shops and houses; the extreme variation of potential from point to point not being greater than 4 volts, and being regulated from the Central Station by keeping a standard pressure at one of three points in the network. The Argentina Theatre is lit by 1,800 incandescent lamps, and 11 arc lamps, worked off 12 transformers, having their secondary circuits in parallel. Each arc lamp has a resistance in series with it which absorbs about 10 volts, and without this resistance the arc lamps are not found to work steadily. With this resistance, however, they give a very excellent result; and the chief cafés, theatres, the railway station, and some of the larger shops, present a very fine exhibition of alternate-current lighting. It may be remarked in passing that a mere dead resistance should not be used for the purpose of steadying alternate-current arc lamps. A choking coil, preferably one having an air gap

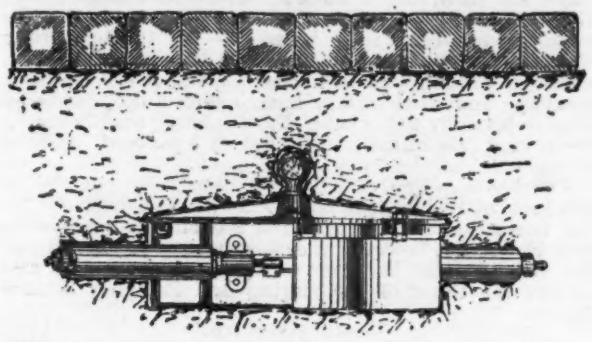


FIG. 22.—JUNCTION-BOX, SIEMENS AND HALSKE CABLE.

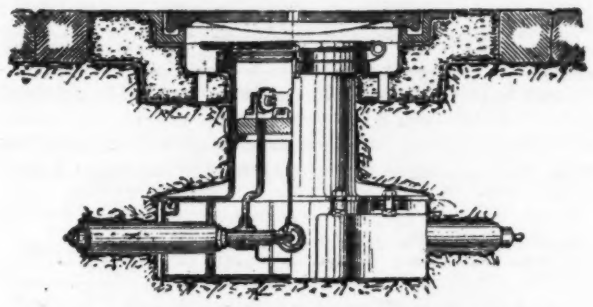


FIG. 23.—SURFACE-BOX FOR BRANCH JUNCTION.

in it for reasons already given (see Vol. I., p. 267, *The Alternate-Current Transformer*), would afford the best means of securing the necessary steadiness.

This is not the proper place to enter into the vexed question of alternate *versus* continuous current arc lamps. The fact that at Rome 300 or more arc lamps are being employed indicates the necessity for making provision for arc lighting; and the economical question which has to be faced is whether the gain in simplicity of working by a uniformity of system is or is not counterbalanced by the disadvantages of intrinsic economy in the alternating par-

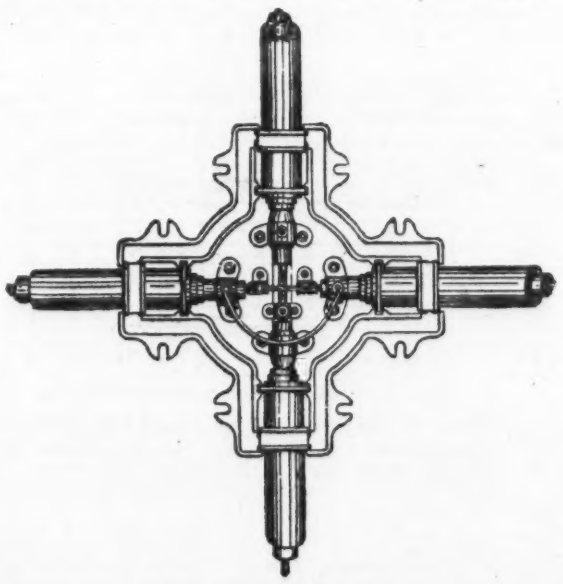


FIG. 24.—CROSS-JUNCTION.

allel-worked arc as compared with series-worked arcs of equal mean candle power, operated on separate circuits and by separate machines and, perhaps, engines.

§ 8 *Change-over Switch* (Zipernowsky, Déri, Bláthy).—Although the dynamos in the Central Station at Rome are of different sizes, it has been found perfectly possible to work them in parallel together. As a regular rule this is not done, but each one of the three mains is supplied by a separate dynamo according as the load on it requires. As there are six dynamos and three main conductors the problem presented was to connect any one of the six dynamos to any one of the three mains, and to make any necessary change in the combination without extinguishing the lights. This has been solved by the construction of an exceedingly ingenious switch-board which effects these changes with ease and certainty. The switch is an elaborate arrangement and somewhat costly to construct. It will best be understood by the following diagrammatic sketches.

On a suitable framework is carried a series of pairs of copper bars (see Fig. 25) D_1, D_2, D_3. D_1 and its fellow (not shown) are in connection with the poles of one dynamo. Similarly, D_2 and its fellow are in connection with the poles of a second dynamo, and so on. These bars are carried on insulators, and have pendant iron rods, d_1, d_2, d_3. There is a second series of pairs of copper bars, F_1 and its fellow (not shown), F_2 and F_3, and so on, which are in connection with the two leads of various cables. From these bars F_1, F_2, etc., are also pendant iron rods f_1, f_2, etc., and these are placed near the pendant rods, d_1, d_2, etc. Mercury cups, 1, 2, 3, etc., can be raised or lowered by a mechanism to be described, by which these pendant rods can be put in electrical connection, so that f_1 is joined to d_3, or to d_2, or to d_1, according as mercury cups 1, 2, or 3 are raised. Hence, we see that the bars, D_1, D_2, D_3, can be electrically joined to the bars, F_1, F_2 and F_3, pair and pair, in any combination; and we must suppose that the fellow bars not shown in the figure, but which are the duplicate bars for the other side of the dynamo, are coupled similarly simultaneously. Suppose, for instance, that the mercury cups, 1, 5, 9, are raised and the rest kept down; then D_3 is joined to F_1, D_2, to F_2, and D_1 to F_3. Thus, any dynamo can be put on any cable. Supposing that each dynamo is working on a cable, and it is desired to interchange the positions of the dynamos, this can be done by raising and lowering mercury cups. For instance, let D_1 be joined to F_3, and D_3 to F_1, and let it be requisite to interchange the dynamos. What has to be done is to lower the mercury cups, 1 and 9, and raise the mercury cups, 3 and 7, and, if this is done very quickly, the dynamos and circuits will be

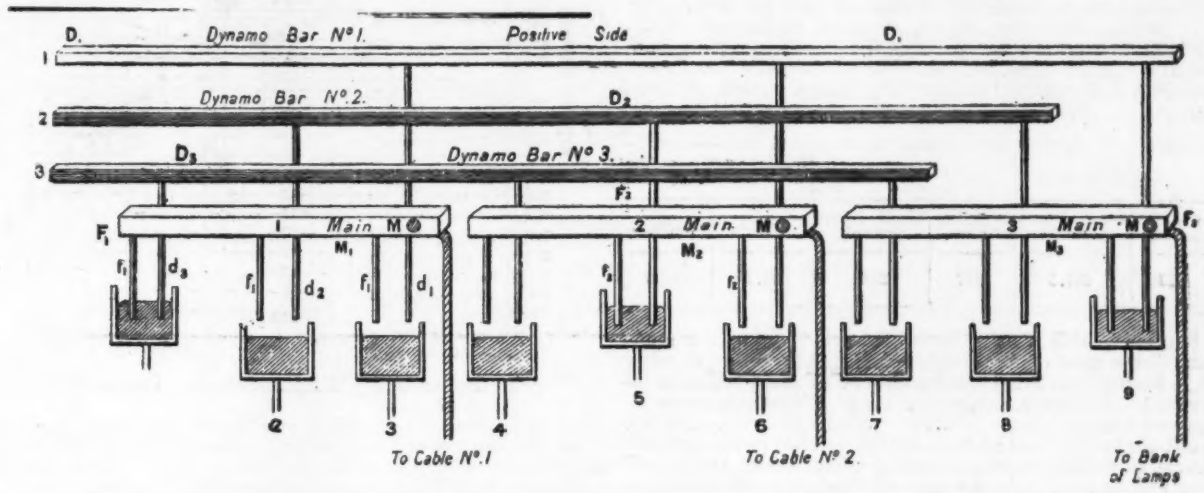


FIG. 25.—ONE SIDE OF CHANGE-OVER SWITCH IN CENTRAL STATION, ROME.

interchanged without any sensible interruption of current. The mechanism for raising one group of mercury cups and lowering another, simultaneously, is carried below the frame which supports the copper bars. The mercury cups are carried in pairs (see Fig. 26) on a table, T, so that the dynamo and feeder pendant bars, F and D, from one side of the dynamo, dip in one cup, and the fellow bars, F' and D', belonging to the other side of the dynamo, dip in the other cup. This table, T, is carried on a pair of steel rods R, R', which are crossed at the middle by a slotted distance piece, L, and the weight of the table and cups is balanced by a balance-weight below, not shown in the figure. The slotted bar, L, is traversed by the pin, P, of a crank, C. This crank is on a shaft, Q, working through a bearing, B, and the other end of the crank is supported by a pin, p, working in a bearing in the back of a slotted block, S, the slot in which is just wide enough to receive the square web of the crank, C, when the shaft, Q, is pushed forward by the handle, H, as far as it can go. When the shaft, Q, is pushed forward so that the crank arm, C, engages in the slot in the block, S, it is easily seen that the crank can only be moved round with the mitre wheel W; but that when withdrawn it has an independent motion of rotation. By turning the handle, H, when the crank is disengaged from the block, S, the mercury cups can be raised or lowered through the distance of the "throw" of the crank, but, if the crank is engaged in the block, S, then the rise and fall of the table can be effected by the rotation of the wheel, W. The crank can obviously be turned or inserted into the block, S, either in the upper position or in the lower, and then a half-turn of the wheel, W, will either lower the cups or raise them.

Imagine a series of such cranks placed side by side (see Fig. 27) and each supporting its table and pair of mercury cups; and suppose the mitre wheels W, attached to each shaft to engage in a series of mitre wheels W', all keyed on one long shaft. If a handle, K, is given half a turn, it will turn all the slotted blocks, S, half round and it will raise, or lower, or not move the table corresponding to each crank, according as that crank has been engaged previously in the slotted block in the upper or lower position, or withdrawn so as not to engage at all.

It is, therefore, obvious that by an appropriate position for each handle, any of the pairs of mercury cups can be caused to rise, or fall, or not to be moved, when the handle K is turned half round. Returning to Fig. 25, we can now see that a mechanism can be suitably arranged to effect simultaneously the electric connection or disconnection of any dynamo from any main, and that any possible combination can be instantaneously exchanged for the other. In the change-over switch at Rome there are four pairs of bars corresponding to the three mains, and to a bank of 3,600 lamps which is used as an artificial load on which to run up each dynamo to speed.

If any main is being operated by any dynamo and it is

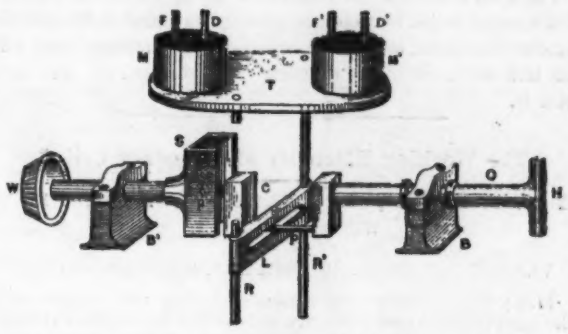


FIG. 26.—CRANKS FOR MOVING MERCURY CUPS.

desired to replace this dynamo by another, the incoming dynamo is first run up to the same ampères and volts as that of the circuit dynamo it is about to replace. The change over switch is then brought into action to interchange the dynamos working on the circuit and that working on the artificial load; and so perfect is the operation of this switch that, when smartly worked, not the slightest wink can be seen on the circuit lamps. This switch is used to replace the small day dynamos by the bigger ones at nightfall, or to effect any interchange necessary. It is, no doubt, an expensive switch-board to construct, but it does its work admirably.

(To be Continued.)

Introducing Metallic Telephone Circuits.

In speaking recently of the fact that out-of-town subscribers have less trouble with their telephones than some city users of the instruments, Mr. J. J. Carty, managing electrician for the Metropolitan (New York) Telephone Company, explained the reason for this state of affairs in the fact that the local lines are all on the single wire

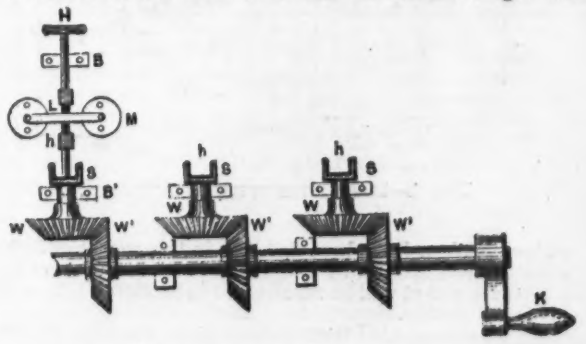


FIG. 27.—MITRE-WHEELS IN CHANGE-OVER SWITCH.

system, while for long distances the metallic circuit is used. Mr. Carty added:

"The company has arranged, at some additional expense, to supply subscribers with the metallic circuit service gradually, so as not to involve a great and immediate expense. Not much has yet been said about it, but the company will probably soon have a general proposition to submit to the public upon this matter. The change will come, without any doubt, and because the public will not do without the best service that can be supplied. A few enterprising business men will first employ the metallic circuit, and others, finding how much better it is than the single wire, will follow. The metallic circuit during the change will be articulated with the single wire system. Two metallic circuit subscribers conversing would thoroughly appreciate the superiority of the system. A metallic circuit subscriber conversing with a single wire subscriber would hear and be heard better than if his was a single

wire service; but the single wire service is often irregular and aggravating.

"The new buildings and switchboards, here in Cortlandt street and in Thirty-eighth and Spring streets, are designed to work with the metallic circuit system, and undoubtedly all future stations established by this company will also be so constructed."

The metallic circuit is now used in the offices of THE ELECTRICAL WORLD; and we take the liberty of pointing out to Mr. Carty the fact that in order to bring about the end he suggests—of which we are heartily in favor—this system must be made so greatly superior to the single-wire connections that all "enterprising" subscribers will see the advantage of making the change, as we have seen it.

The Working Efficiency of Secondary Cells.*

BY W. E. AYRTON; C. G. LAMB, E. W. SMITH, M. W. WOODS, Associates.

VI.—RESULTS OBTAINED WITH AUTOMATIC APPARATUS.

Many preliminary experiments having been made with the automatic apparatus, we succeeded in making it work quite satisfactorily by the beginning of May, 1889, and it was adjusted to charge five accumulators, *A* (Fig. 5), with a steady current of 9 ampères until the P. D. reached 2.4 volts per cell, and to discharge them with a steady current of 10 ampères until the P. D. fell to 1.6 volts per cell. After 13 days and nights had been spent in continuous charging and discharging, the cells reached a normal state, the time rise of P.D. in charging and the time fall in discharging being at length repeated over and over again, so that when the time curves were drawn for the successive charges they exactly coincided, and so for the discharge curves. The areas of these curves—reckoned, of course, from the zero of P. D., which is much below the figure as here shown—may thus be said to give the "working watt hours" for charge and for discharge when the charge and discharge are effected between limits of 1.6 and 2.4 volts per cell. Fig. 6 shows the discharge curves obtained on May 16, 17, 18, and 19, the points for each of the discharges being indicated by points differently marked as stated on the figure; and Fig. 7 shows the intermediate charge curves obtained on May 17, 18, and 19. Integrating these curves, we find:

Discharge.		Charge.		Percentage working efficiency.	
Ampère hours.	Watt hours per cell.	Ampère hours.	Watt hours per cell.	Quantity.	Energy.
115	221.8	117	256.2	98.3	86.5

Soon after this very concordant set of results was obtained, the time of charging, which had remained steadily at 13 hours from the commencement of May, began to increase to 15½ hours, while the time of discharge only increased half an hour—that is, to about 12 hours. At first we thought that we had been trying to charge the cells too much, so we stopped the charging when the P. D. per cell rose to 2.35 volts; but the time of charging still continued to increase, until at last it rose to 24 hours, the time of discharge still remaining about 12 hours. On again reducing the P. D. limit on charging, the P. D. per cell now refusing to rise to 2.35 volts, both the times of charging and discharging became very irregular, and at length the time of charging suddenly fell to 10 hours and the time of discharging to 6. On carefully examining the plates, they were found to have badly scaled, and to have suddenly become partially short circuited; they were, therefore, carefully scraped, and the mud allowed to settle at the bottom, where, in consequence of the special construction of the 1888 cell, it could remain without short-circuiting the

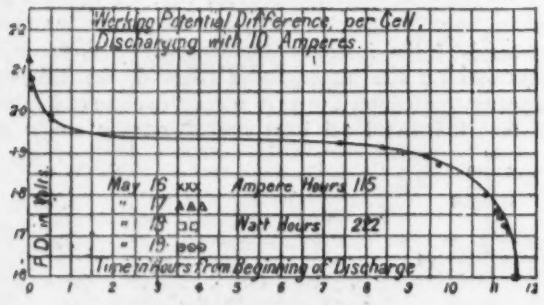

Working Potential Difference per Cell.
Discharging with 10 Amperes.
May 16 xxx Ampere Hours 115
" 17 ▲▲▲ Watt Hours 222
" 18 □□
" 19 ●●●
P.D. in Volts
Time in Hours from Beginning of Discharge

FIG. 6.—DISCHARGE WITH 10 AMPERES.

plates. Only a few plugs fell out in this operation. This sediment was afterward weighed and analyzed, showing a composition that will be referred to in Section VIII., on the Chemical Action.

We now concluded that we had been running the cells too low, and we therefore decided to stop the discharge when the P. D. per cell fell to 1.8 volts, retaining the higher limit of 2.4 volts per cell to limit the charge. It is interesting to notice that Dr. Louis Duncan and Mr. H. Wiegand, in their paper on "The Inherent Defects of Lead Batteries," read before the American Institute of Electrical Engineers, and which we saw for the first time at the end of June, 1889, reprinted in THE ELECTRICAL WORLD, come to exactly the same conclusion—that the discharge should be terminated at 1.8 volts per cell, otherwise there is a formation of white lead sulphate and a rapid depreciation of the cell. From what we have since seen we think that the discharge should be stopped even sooner—when the P. D. per cell has reached 1.9, or 1.85 volts at the lowest.

We therefore adjusted the automatic interruptor to stop the discharge when the P. D. per cell was 1.8 volts, and the immediate result of this was to bring the time of charging up to 12½ hours, and to bring up the time of discharging to 10½ hours. After continuing the charging and discharging continuously day and night for 13 days, the cells reached a perfectly steady state. Curve 8 shows the time curve of P. D. per cell in the discharges finished in the early morning of June 19, recommenced in the night of June 19, and again commenced late on June 20, all the three discharges being so precisely similar that they can be represented by one curve; and, similarly, curve 9 shows the intermediate charging curves on June 18, 19 and 20, which were also exactly the same. The times of the three discharges and of the three charges were, respectively, in hours and minutes.

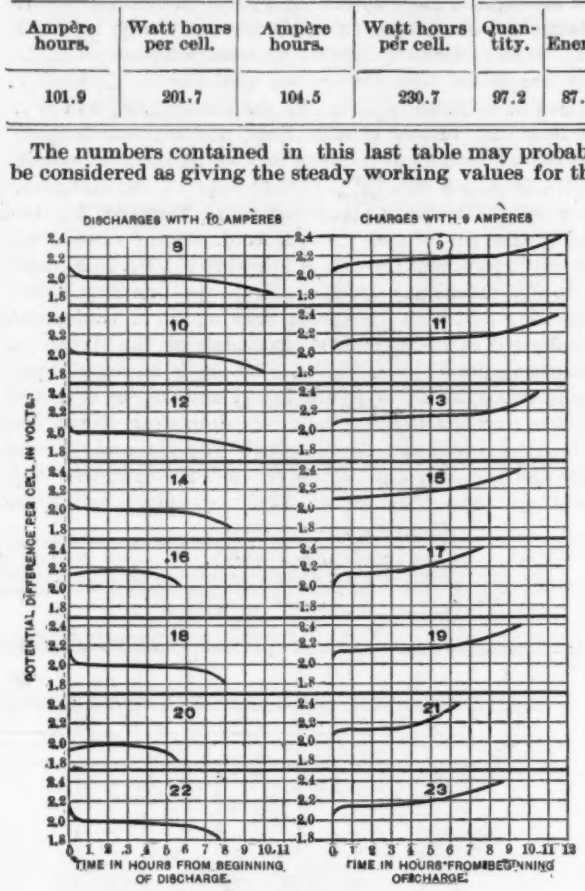
Times of successive Discharges.	Charges.	Times of successive Discharges.	Charges.
10 h. 10 m.	11 h. 38 m.	10 h. 11 m.	11 h. 37 m.
10 h. 10 m.	11 h. 37 m.		

showing to what an absolutely definite state cells arrive after a definite cycle of charge and discharge between fixed limits has been repeated continuously without interruption for some weeks.

Integrating these curves, we find:

Discharge.		Charge.		Percentage working efficiency.	
Ampère hours.	Watt hours per cell.	Ampère hours.	Watt hours per cell.	Quantity.	Energy
101.9	201.7	104.5	230.7	97.2	87.4

The numbers contained in this last table may probably be considered as giving the steady working values for this


DISCHARGES WITH 10 AMPERES
CHARGES WITH 9 AMPERES
POTENTIAL DIFFERENCE PER CELL IN VOLTS.
TIME IN HOURS FROM BEGINNING OF DISCHARGE.
TIME IN HOURS FROM BEGINNING OF CHARGE.

CURVES 8 TO 23, DISCHARGES AND CHARGES.

size and type of cell; 230.7 watt hours are equivalent to 612,200 foot pounds, and as the positive and negative plates of one cell weigh 28 pounds 10 ounces, the *working* storage capacity is 21,380 foot pounds per pound of plate.

VII.—EFFECT OF REST.

We next tried the effect produced on the capacity and efficiency of accumulators by prolonged rests. The five cells used in the experiments stood on porcelain insulators containing resin-oil; and as the insulators, which were specially made for the Central Institution, were taller than those commonly employed to support accumulators, and as all connecting wires were removed from the cells while they were allowed to rest, it is certain that any change in the cells must have been caused by internal action, and could not have been due to external leakage.

The cells, having been fully charged on June 22d, were allowed to rest, insulated as above described, until July 2d—that is, for 10 days. The first few curves of discharge and charge after the rest showed a considerable diminution in the capacity and efficiency; but after one week's continuous charging day and night a steady cycle was reached, the following being the times of successive discharges and charges, the limiting P.Ds., as before, being 1.8 and 2.4 volts:

Times of successive Discharges.	Charges.	Times of successive Discharges.	Charges.
10 h. 1 m.	11 h. 35 m.	9 h. 58 m.	11 h. 32 m.
9 h. 59 m.	11 h. 30 m.	9 h. 57 m.	11 h. 33 m.

Curves 10 and 11 show the variation of the P. D. per cell, and on integrating these curves we obtain—

Discharge.		Charge.		Percentage working efficiency.	
Ampère hours.	Watt hours per cell.	Ampère hours.	Watt hours per cell.	Quantity.	Energy.
100	198	103.8	228.2	96.4	85.8

Rest, then, of an accumulator, although left well insulated and fully charged at the commencement, alters the accumulator so that for the first few charges and discharges after the rest it is a much less valuable instrument than before. A week's continuous charging and discharging day and night, however, removes this effect to a great extent; the efficiency, however, still remains somewhat lower than before the rest.

Next, the cells were allowed to rest charged 12 days, until Aug. 1. The first discharge at the end of the rest gave a quantity efficiency of only 80 per cent., so that 20 per cent. of the charge was lost. After a week's continued charging and discharging between the former limits of volts, the cells regained a steady state, but the time of charge and of discharge is now less than before this second rest. The times after the week's charging and discharging were:

Times of successive Discharges.	Charges.	Times of successive Discharges.	Charges.
9 h. 3 m.	10 h. 41 m.	9 h. 10 m.	10 h. 51 m.
9 h. 2 m.	10 h. 44 m.		

Curves 12 and 13 show the P. D. curves when the cells had acquired a steady state, and on integrating them we find—

Discharge.		Charge.		Percentage working efficency.	
Ampère-hours.	Watt-hours per cell.	Ampère-hours.	Watts-hours per cell.	Quantity.	Energy.
91	176.7	96.8	213.2	94.1	82.8

We see, then, that a week's continuous charging and discharging of these cells is unable to compensate for the harm produced by their being left for 12 days fully charged. The two rests of 10 days and 12 days respectively, although followed in each case by a week's continuous charging and discharging, have reduced the discharge ampère-hours by 10 per cent., the discharge watt-hours by 12 per cent., the quantity efficiency by 3 per cent., and the energy efficiency by 5 per cent.

Third Rest.—The cells having been fully charged, a third rest of 16 days took place. On the first discharge, at the normal rate of 10 ampères, the ampère-hours were only 75. After, however, the charging and discharging at the normal rates had been continued for three days and nights, the times of discharging and charging became steady.

Times of Successive Discharges.	Charges.
8 h. 12 m.	9 h. 28 m.
8 h. 17 m.	9 h. 35 m.
8 h. 19 m.	9 h. 35 m.

and Curves 14 and 15 show the working values of the P.D. in discharging and charging. Integrating the curves, we obtain:

Discharge.		Charge.		Percentage working Efficiency.	
Ampère hours.	Watt hours per cell.	Ampère hours.	Watt hours per cell.	Quantity.	Energy.
82.6	161.3	86.2	190.5	95.8	84.7

Fourth Rest.—The cells, having been fully charged, were allowed to rest for 16 days. Curve 16 gives the values of P. D. obtained at the *first discharge*, and Curve 17 the values of the P. D. obtained immediately afterwards in charging. Integrating the former curve, and comparing its area with the area of the charge curve (15) obtained just before the rest, we find—

First discharge after rest.		Last charge before rest.		Percentage Efficiency.	
Ampère-hours.	Watt-h'r's per cell.	Ampère-hours.	Watt-h'rs per cell.	Quantity.	Energy.
56.5	110.5	86.2	190.5	65.5	58

If, however, we compare the result of the first discharge after the rest with the first subsequent charge, shown in Curve 17, we find:

First discharge after rest.		First charge after rest.		Percentage efficiency.	
Ampère hours.	Watt-hr's per cell.	Ampère hours.	Watt-h'rs per cell.	Quantity.	Energy.
56.5	110.5	71.1	158.3	79.6	69.6

The cells were now continuously, without intermission, charged with the normal current of 9 ampères, and discharged with 10; the discharge, as before, being automatically stopped when the P. D. per cell had fallen to 1.8 volts, and the charge when it had risen to 2.4 volts. The following give the successive times in hours and minutes in which the cycles were completed:

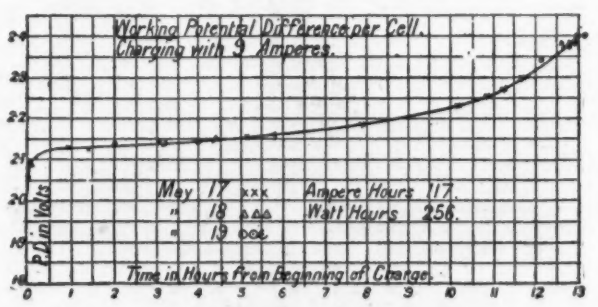

Working Potential Difference per Cell.
Charging with 9 Amperes.
May 17 xxx Ampere Hours 117.
" 18 ▲▲▲ Watt Hours 256.
" 19 ●●●
P.D. in Volts
Time in Hours from Beginning of Charge.

FIG. 7. CHARGE WITH 9 AMPERES.

First discharge after rest, 5 h. 40 m.	First charge, 7 h. 54 m.
Second discharge after rest, 7 h. 6 m.	Second charge, 8 h. 30 m.
Third discharge after rest, 7 h. 31 m.	Third charge, 8 h. 51 m.
Fourth discharge after rest, 7 h. 29 m.	Fourth charge, 8 h. 52 m.
Fifth discharge after rest, 7 h. 43 m.	Fifth charge, 9 h. 17 m.
Sixth discharge after rest, 8 h. 0 m.	Sixth charge, 9 h. 24 m.
Seventh discharge after rest, 8 h. 5 m.	Seventh charge, 9 h. 17 m.
Eighth discharge after rest, 7 h. 57 m.	Eighth charge, 9 h. 20 m.

From the last three discharges and charges we see that the cells have arrived at a steady state, and curves 18 and 19 show the steady, or working, values of the P. D. for these three discharges and charges. Integrating the areas of these two sets of curves we find:

Discharge.		Charge.		Percentage Working Efficiency.	
Ampère hours.	Watt hours per cell.	Ampère hours.	Watt hours per cell.	Quantity.	Energy.
80	156.9	83.8	184.6	95.5	85

Fifth Rest.—The cells were now left charged for a further period of 16 days. Curve 20 gives the values of

*Continued from THE ELECTRICAL WORLD, Aug. 16, 1890.

the P.D. obtained at the first discharge after the rest, and Curve 21 the values of the P.D. obtained immediately afterwards in charging. Integrating the areas of these curves, we have—

First Discharge after Rest.		Last Discharge before Rest.		Percentage Efficiency.	
Ampère Hours.	Watt Hours per Cell.	Ampère Hours.	Watt Hours. per Cell.	Quantity.	Energy
53.3	104.1	83.8 First Charge	184.6 after rest.	63 3	56.4
		58.5	128.3	91 1	81.1

Continuous charging and discharging with the normal currents between the normal limits of P. D. per cell gave the following times for completing the cycles:

First discharge after rest. 5. h. 20 m.	First charge,6 h. 30 m.
Second discharge after rest, 6 h. 18 m.	Second charge, 7 h. 29 m.
Third discharge after rest, 6 h. 42 m.	Third charge, 7 h. 59 m.
Fourth discharge aftor rest, 6 h. 54 m.	Fourth charge, 8 h. 19 m.
Fifth discharge after rest, 7 h. 15 min.	Fifth charge, 8 h. 20 m.
Sixth discharge after rest, 7 h. 16 m.	Sixth charge, 8 h. 30 m.
Seventh discharge after rest, 7 h. 23 m.	Seventh charge, 8 h.41 m.
Eighth discharge after rest, 7 h. 34 m.	Eighth charge, 8 h. 44 m.
Ninth discharge after rest, 7 h. 40 m.	Ninth charge, 8 h. 47 m.

It was concluded from the times of the last three charges and discharges that the cells had acquired a steady state, and Curves 22 and 23 show the time fall and the time rise of P. D. Integrating the areas of these curves, we have—

Discharge.		Charge.		Percentage working efficiency.	
Ampère hours.	Watt hours per cell.	Ampère hours.	Watt hours per cell.	Quantity.	Energy.
76	149.5	78.3	173.2	97.1	86.3

The following table gives a *resumé* of these results, all the discharges being made with 10 ampères until the P. D. fell to 1.8 volts per cell, and all the charges being made with 9 ampères until the P. D. per cell rose to 2.4 volts. Before each rest the cells were charged until the P. D. per cell was 2.4 volts.

The smallness of the first discharge after a rest might be due either to a kind of electric short-circuiting and dissipation of the energy, or to some change in the character of the active material converting the energy perhaps directly into heat, or to some of the active material having become disconnected from the plates during the rest and having fallen down to the bottom of the cell. The smallness of the first *charge* subsequently to the first discharge after the rest, shows that mere electrical leakage during that time has not been the cause of the loss of energy, while the steady increase in the storage capacity brought about by a series of charges and discharges tends to show that rest brings about some change in the nature of the active material.

In all the tests in which the results are given in the preceding table, the charge and discharge were, as already stated, terminated when the P. D. per cell reached a fixed value; it is, therefore, possible that the apparent falling off in the capacity of the cells to store energy may be due to a change in the resistance of the cells produced by the rest. For a change in the resistance of the cells will change the terminal P. D. for a given current flowing through the cells without there being any necessary change in the storage capacity.

It is, therefore, interesting to study the variations in the shapes of the P. D. curves 8 to 23. First, as regards the charge curves, 9 and 11 are convex everywhere to the axis of time except just when the charging is commenced; whereas 13, the steady working charge curve after the second rest, rises much more rapidly when the P. D. cell is about 2.3 volts than is the case in the other two curves, then bends over and becomes concave to the axis of time. This peculiarity in Curve 13 is, we notice, not very striking in the small reproduction of this curve in the text, but in the original curves as plotted on large sheets of squared paper from the results of the tests, the difference between Curves 11 and 13 is very noticeable.

The following list gives the time in hours and minutes from the commencement of the charging when the P. D. per cell reaches 2.2 volts.

Curve 9 .. 7 h. 14 m. .. Steady working charge before rests.
" 11 .. 7 h. 32 m. .. " " " after first rest.
" 13 .. 7 h. 10 m. .. " " " " second rest.
" 15 .. 5 h. 36 m. .. " " " " third rest.
" 17 .. 3 h. 54 m. .. First charge after fourth rest.
" 19 .. 5 h. 43 m. .. Steady working charge after fourth rest.
" 21 .. 4 h. 50 m. .. First charge after fifth rest.
" 23 .. 4 h. 40 m. .. Steady working charge after fifth rest.

It is clear, then, that the effect of a series of rests is to cause the P. D. to rise much more rapidly in subsequent charges, and the time curve rise of P. D. still remains unseconds, the latter rate of rise being almost exactly equal to the former rate of fall.

All the rests already referred to occurred when the cells were fully charged; but before these long rests took place the cells, when in their normal state, were on one occasion allowed to remain discharged for 34 minutes, with the following result:

Cells in Normal State.

Time taken to complete—
Discharging 10 h. 10 m. Charging 11 h. 38 m.
Next " 10 h. 12 m. Next " 11 h. 37 m.
Next " 10 h. 11 m. Next " 11 h. 37 m.
Cells here remained discharged for 34 minutes.
First charging after rest, 11 h. 50 m.
First discharging after rest, 10 h. 15 m.
Next charging after rest, 11 h. 42 m.

These results emphasize the fact that accumulators are damaged if left discharged even for a short time, and it was for this reason that during the whole of this investigation the cells were never left discharged for a longer time than was necessary to change over the connections from discharge to charge, except on this one occasion when it was desired to ascertain the magnitude of the change produced by leaving the cells discharged for a short time.

It is interesting to notice that the effect of discharging cells too low, or of leaving them discharged, is to increase the times required for the subsequent chargings, whereas the effect of leaving them charged is to diminish the times required for the next chargings.

(To be continued.)

DISCHARGE.				CHARGE.				PERCENTAGE EFFICIENT.	
Duration of Discharge.	Ampère Hours.	Watt Hours per Cell.	Number of Curve.	Duration of Charge.	Ampère Hours.	Watt Hours per Cell.	Number of Curve.	Quantity.	Energy.
				Cells in Normal State.					
h. m. 10 12	101.9	201.7	8	h. m. 11 38	104.5	230.7	9	97.2	87.4
	Rest of 10 days. Cells then charged and discharged many times until brought to a steady working state.								
10 0	100	196	10	11 31	103.8	228.2	11	96.4	85.8
	Rest of 12 days. Cells then charged and discharged many times until brought to a steady working state.								
9 8	91	176.7	12	10 45	96.8	213.2	13	94.1	82.8
	Rest of 16 days. Cells then charged and discharged several times until brought to a steady working state.								
8 24	82.6	161.3	14	9 36	86.2	190.5	15	95.8	84.7
	Rest of 16 days. *First* discharge and charge after rest							Ratio of first discharge *after* rest to last charge *before* rest. 65.4	58.0
5 41	56.6	110.5	16	7 54	71.1	158.3	17	Ratio of first discharge *after* rest to first charge *after* rest. 79.6	69.6
	Cells now charged and discharged several times until brought to a steady working state.								
8 0	80	156.9	18	9 20	83.8	184.6	21	95.5	85.0
	Rest of 16 days. *First* discharge and charge after rest.							Ratio of first discharge *after* rest to last discharge *before* rest 33.6	56.4
5 21	53.3	104.1	20	6 30	58.5	128.3	21	Ratio of first discharge *after* rest to first charge *after* rest. 91.1	81.1
	Cells now charged and discharged several times until brought to a steady working state.								
7 6	76	149.5	22	8 12	78.3	173.5	33	97.1	86.3

From the preceding table it will be seen that, in spite of the continued charging and discharging at the end of each rest, there is a steady falling off in the quantity capacity from 101.9 ampère-hours at the beginning to 76 ampère hours at the end, and in the energy capacity from 201.7 watt-hours to 149.5 watt-hours. The quantity and energy efficiencies, 97.1 and 86.3 per cent. respectively, at the end are the same as at the beginning. Comparing the first discharge after each of the 16 days' rest with the last charge before the rest, there appears to be a loss of about 36 per cent. in the ampère hours, and about 43 per cent. in the watt-hours; or, since the normal quantity and energy efficiencies for a discharge immediately following a charge are respectively 97 and 87 per cent., it follows that the rest of 16 days causes a loss of about 33 per cent. in the ampère-hours, and about 30 per cent. in the watt-hours, in addition to the losses that normally occur on a charging immediately followed by a discharging.

From all that precedes, it follows that the previous history of an accumulator produces an enormous effect on its efficiency. If, for example, an E. P. S. accumulator be over and over again carried round the cycle of being charged up to 2.4 volts per cell and discharged down to 1.8 volts per cell, the charging and discharging currents being the maximum allowed by the makers—viz., 0.026 ampère per square inch in charging, and 0.029 ampère per square inch in discharging—the "*working efficiency*" thus obtained may be 97 per cent. for the ampère-hours and 87 per cent. for the watt-hours. If, on the contrary, the cell be constantly charged up before being tested, then for the first few charges and discharges between the above limits, and with the same current density in charging and discharging, even the *energy* efficiency may be as high as 93 per cent; whereas, if the accumulator has been left for some weeks, then, although it was left charged, the energy efficiency for the first few charges and discharges will be as low as 70 per cent.

While, on the one hand, our tests show that continued rests of a charged accumulator appear to be far more serious for the accumulator than we had previously imagined, the working efficiency appears to be higher than has hitherto been supposed, since we believe that about 84 per cent. efficiency in the watt-hours is all that the advocates of accumulators have claimed for them.

usually steep, although at the end of every rest there was a prolonged, and uninterrupted, series of charges and discharges.

Curves 16 and 20, which give the values of the P. D. for the *first* discharges after the fourth and fifth rest, show that for the first hour from the beginning of each of these discharges the P. D. *rises instead of falling*, as is the case in normal discharges.

If the rapid fall of P. D. at the commencement of a discharge be due to a disappearance of gases occluded in the plates, as some have supposed—or if, as Dr. Gladstone and Mr. W. Hibbert imagine, the charging of a cell causes the acid round the positive plate to become denser than that round the negative, and the mixing of the denser and less dense acid at the commencement of the discharge causes the P. D. to fall—then the absence of this fall at the beginning of a discharge after a long rest would be explained; but neither of these theories would apparently explain the rise of the P. D. obtained by us at the commencement of a discharge after a long rest. Indeed, the fact that it required two discharges and two charges after a long rest before the discharge curve (the third after the rest) acquired its normal form, tends to show that this rise of P. D. at the commencement of the first discharge after a long rest is due to some other cause.

Again, Professor Duncan and Mr. H. Wiegand have shown in their communication that the diffusivity of the sulphuric acid into the plugs is greatest at the end of the charge, and least at the end of the discharge. Hence, if it be the diffusing out of the strong sulphuric acid from the plugs of the positive plate that causes the rapid fall of E. M. F. on breaking the charging circuit at the end of a charge (see Figs. 3, 4 and 11), one would hardly expect that it would be at the *end* of the discharge, when the diffusivity of the acid in the plugs was a minimum, that the rise of E. M. F. on breaking the discharging circuit would be most rapid, but that numerous experiments have shown us to be the case. In fact, a later experiment shows that toward the end of the charge the E. M. F, falls from 2.298 to 2.274 volts in 20 seconds after breaking the charging circuit, and similar curves that we have drawn from our experiments on the time rise of E. M. F. on breaking the discharging circuit show that toward the end of the discharge the E. M. F. rises from 1.951 to 1.970 volts in 20

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-177 TIMES BUILDING, NEW YORK, Aug. 18, 1890.

Mr. George Cutter, of the Great Western Electric Supply Company, Chicago, was in this city last week to spend a few days before going to the Cape May Convention.

Extension of Electric Lines.—The Brooklyn City Railroad Company has bought the franchise granted to the South Brooklyn Street Railroad Company for a surface road from Thirty-ninth street in Second avenue, and Fifty-second street to the city line, with an extension in New Utrecht and Flatbush to Blythebourne and Parkville. The motive power to be used on the road is to be either cable or electricity.

Injunction Dissolved.—The people of the village of Jamaica, L. I., who got temporary injunctions restraining the Brooklyn and Jamaica Road Company from running electric cars along the main street of their town, lost their suit against the company last week. Justice Cullen dissolved the injunction against the further use of electricity. The use of electricity, he held, was technically in violation of the corporate rights of the company, but it had been employed as a motive power for two years without any objection from the villagers.

No Subway Injunction.—Judge Beach, of the Supreme Court, has denied the application of the North American Underground Telegraph and Electric Company for an injunction restraining the Consolidated Telegraph and Electrical Subway Company and the New York Underground Telegraph Company from using any subway system other than the Johnstone system. The injunction would probably seriously retard and interfere, the decision says, with a public work prosecuted by the board of electrical control under authority of the State.

The East River Electric Light Company, this city, has mortgaged its rights and franchises to the Holland Trust Company for $600,000. In 1885, when it was organized, it mortgaged its effects to the same company for $300,000. Under the assignment the original loan is taken up, and the company gets the $300,000 additional for its immediate use. The East River Company has not extended its wires through the subways over the extent of territory which its overhead wires occupied. With this $300,000 its officers say it will make all necessary extensions and enlarge its plant at 425 East Twenty-fourth street.

Officers of a New Phonograph Company.—By papers filed last Friday with the Secretary of State at Albany there has been recorded an amalgamation of various corporations which had interests in the phonograph. The various branch companies have been combined in one corporation named the New York Phonograph Company, whose president is John P. Haines, the successor of Henry Bergh, the vice-president being John D. Cheever, and the secretary and treasurer Richard Townley Haines. The other directors are ex-Judge Noah Davis, Dr. W. Seward Webb, William Fahnestock and John L. Martin.

The McDougall Electric Car.—A number of gentlemen interested in modern methods of street-car traction witnessed the first preliminary trial trip of the new McDougall storage battery electric car last week on Seventh avenue, this city. Among those present were President W. T. Moore, of the Brush Electric Light Company; General Manager Charles S. Spear, of the same company; Malcolm Campbell, of Booth & Campbell; Robert L. Coddington, Superintendent Newell, of the Broadway and Seventh avenue road G. K. Sheridan, W. N. Van Voorhis, president of the company, and John W. Timpson. The car carries 144 Gibson storage cells, and is equipped with the McDougall motor. The trial was a complete success. A company has been organized to build the motor with a capital of $500,000 The officers are: W. N. Van Voorhis, president; W. I. Westcote, vice-president; John W. Timpson, secretary and treasurer; W. M. McDougall, general manager; Townsend Walcott, electrician.

W. T. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 8, Cook Building, cor. Franklin and Congress Sts.
BOSTON, Aug. 16, 1890.

Mr. S. E. Barton has returned from his Western trip in the interest of the "Electric Mutual."

The Curtis Electric Company has removed from 339 Washington street, this city, to 620 Atlantic avenue.

The Wainwright Company will furnish a 300 h. p. feed water heater for the new Clinton (Mass.) electric light station.

The Edison Electric Illuminating Company of Boston has commenced excavating for the foundations of its new engine house.

Mr. W. A. Giles, general manager and secretary of the Mill and Mine Electric Equipment Company, of Pittsburgh, is on a business trip in the East.

Capt. Wm. Brophy is able to be out after a severe siege of sickness. Mr. W. B. Brophy, son of Capt. Brophy, is meeting with

great success throughout the South and West in placing business for the "Electric Mutual."

The Pettingell Andrews Company has furnished the Okonite wire for the complete wiring of the new electric light station at Worcester, Mass.

The Thomson-Houston Motor Company will test its new coal-cutting machine in a few days. Orders have been received for all machines so far designed.

The Economic Electric Company, of Brockton, Mass., has just finished its first dynamos, and is now testing them. Many new features are to be introduced, and the company has large orders on hand.

The Standard Electric Company, of Vermont, is installing a 500 light incandescent for M. C. Dizer & Co., East Weymouth, Mass. It will be run by the Evans friction cone system. The wiring is being done by Bird & Sloane, of Boston.

Mr. R. D. Smith, superintendent of the Westboro Electric Light Company, Westboro, Mass., has just completed an installation of 249 lights in the New Catholic church at Westboro, doing one of the finest pieces of work in that section of the State, and using Okonite wire entirely.

Hartford, Conn.—The office of the Perkins Electric Lamp Company has been moved from Hartford to Manchester, where the factory is located. Ex-Senator M. S. Chapman is president of the company. Secretary J. J. Gates, who now lives in Hartford, will soon move to Manchester. A majority of the directors of the company live in that town.

The Russell Electric Lamp Company has just brought out a new arc lamp, but 15 inches long, of 1,000 c. p. It burns eight hours with one set of carbons, and is especially designed for inside lighting of stores, churches, etc. This company manufactures lamps of 12, 18 and 24 hours' life on the same principle, and will make a fine display of arc lamps at the St. Louis Exposition.

Brockton, Mass.—It is proposed to construct two lines of electric roads from Brockton to Nantasket beach, one running through Holbrook and Weymouth, and the other by way of Whitman, Rockland and Norwell. As there are now electric roads as far as Quincy, a line will be run from Brockton to Boston, which will be a big competitor for the Old Colony Railroad on local travel.

Fall River, Mass.—A scheme is on foot by which the mills may receive their supplies of machinery, coal and other commodities by means of an electric belt line railroad. Prison Commissioner Greene says the scheme is backed by the Thomson-Houston Electric Company and Boston capitalists. An engineer is surveying the proposed route. The cars will be run by the trolley system.

The New England Printing Telegraph Company, of Massachusetts, was chartered last Wednesday. The company proposes to construct and maintain aerial and underground telegraph lines, and transmit intelligence to be printed by machinery at the various stations on its line. The office of the company is to be in Boston, with F. B. Dale president. The capital is $150,000, in shares of $100 each.

The Wright Electrical Engineering Company has designed and is installing the new electric lighting plant for the Clinton (Mass.) Gaslight Company. The whole building is 143 × 66 feet. The dynamo room is 38 × 61; the engine room, 47 × 45, and the boiler room 49 × 47. Fitchburg compound condensing engines, Robinson boilers, and Evans friction pulleys will be used. This company has also designed and is installing the new plant for the Derby Gas Company, of Birmingham, Conn., which will be a water and steam plant combined. Two 200 h. p. water wheels will furnish power part of the year, and when necessary arrangements have been introduced for belting the steam plant to the same shafting and simply transferring to it. The dimensions of the station are 132 × 60, with projections. The boiler room is 32 × 40; the engine room, 30 × 40; the dynamo room, 40 × 84; the wheel room, 44 × 28, with offices, work shops, etc., attached. Both of these plants are models of the designer's art and reflect great credit on the company. L. H. H.

PHILADELPHIA NOTES.

Branch Office of the Electrical World,
31 City Building, Philadelphia, Aug. 16, 1890.

Mr. J. Elliott Shaw is inhaling the sea breeze along the New England coast.

The Electro-Dynamic Company has increased the plant of Messrs. Brown Bros., of Fourth and Chestnut streets, from 350 to 900 lights.

Messrs. A. Whitney & Sons, are turning out about 75 of their patent contracting chill car wheels per day, for the use of electric street cars.

The Quaker City Electric Company has installed a 100-light plant in the ice-manufacturing establishment of Rudolph S. Herr, of Lancaster, Pa.

Extensive improvements have been made at the Murray Flint Glass Works, and their furnaces stated last week. They report many orders and an excellent business outlook.

The Otto Gas Engine Company has received its third order from the Rockville (Conn.) Gas Company for a 100 h. p. gas engine to be placed in the electric light station for driving dynamos.

Wilmington, Del.—The Wilmington City Railway Company has contracted with C. M. Blanchard of Philadelphia to furnish six 50,000-watt generators and to make all the electrical connections.

Jenkinstown, Pa., is to have an electric light plant that will be one of the finest in the State. A thousand lights are already in, as well as 12 miles of construction. Mr. C. M. Blanchard, of Philadelphia, has had charge of the work

Messrs. High Bros. & Co., engine dealers of 123 North Third street, have taken the agency for the Ironsides motors and dynamos manufactured by Nathan H. Edgerton of this city. These motors are sold at a low figure and the demand for them is large.

Messrs. W. S. Griffith & Co., agents for the Mather motor, are making the following installations: One 10 h. p. motor to operate a passenger elevator in the United Security Building; one 2 h. p. motor for the Pottstown printing office, Pottstown, Pa.; one 6 h. p. motor and pump for Homer Le Boutillier & Co., Chestnut street. They are also installing a 100-light Mather plant for B. W. Titus' Sons, of Trenton, N. J., and have contracts for several larger plants pending.

The new apartment house of W. G. Warden at Eleventh street, corner Pine, is to be fitted throughout with electric lights, the whole house to be wired with the interior conduit system. Messrs. M. R. Muckle, Jr., & Co., who are doing the heating and ventilating work of the house, have received the contract to place two Westinghouse compound engines, 11 and 14x11, to drive the dynamos. Storage batteries will be used, and the dynamos operated only for charging purposes. The boiler and engine house are in an entirely separate building on the opposite side of the street, connection being made through a tunnel. W. F. H.

WESTERN NOTES.

Branch Office of The Electrical World,
465 The Rookery, Chicago, Aug. 16, 1890.

Mr. Foree Bain has taken a short trip to Kentucky on a combined business and pleasure tour.

Mr. J. B. Wallace, of the Electrical Supply Company Ansonia, Conn., was in Chicago for a day or two this week.

Mr. Samuel Insull, second vice-president of the Edison General Electric Company of New York, is in Chicago this week.

Mr. Fuel Oil Leonard, now the western manager of the Hill Clutch Works, Chicago, will drop in to the convention meetings before the adjournment.

Mr. F. W. Best, of Denver, Colo., stopped over in Chicago on Monday, en route East, to select a full stock of electroliers and combination fixtures, and possibly to secure a partner.

Canes.—It will probably be unnecessary for delegates to supply themselves with canes preparatory to visiting Cape May, as our esteemed friend, Colonel J. H. Shay, will be present with the usual package.

The Dawn Electric Company has been incorporated at Chicago to do general electrical construction work. The capital stock is $10,000; incorporators, J. A. McEntee, H. P. Williams and John M. Glem.

Mr. Frank M. Farwell, of the Northwest Thomson-Houston Electric Company, has completed his work at Pullman and gone to St. Louis to superintend the electrical equipment of cars being built for his company at the Laclede works.

The Western Power Construction Company, Chicago, is placing the big 4,000-pound foundation boxes in position in the Chicago Edison station preparatory to receiving the McIntosh & Seymour engines that are to drive the new Edison dynamos.

Hard Rubber Goods.—Mr. M. C. Chase, 80 Market street Chicago, has secured the contract for making the rubber cells required by one of the storage battery companies, and also all the cells required by the maker of a physician's and family battery.

Mr. Charles E. Gregory, general sales agent of the Sperry Electric Company, Chicago, will be at Cape May and there exhibit the new "triple carbon lamp" which his company is now making, and which are intended to replace all single or double carbon lamps now on the market.

The Columbian Exposition.—At a meeting of the Board of Directors on Tuesday evening, Director Jeffrey placed in nomination, to fill a vacancy, the name of Colonel R. C. Clowry, vice-president and general superintendent of the Western Union Telegraph Company, in the interest of the electrical branch of the Exposition, and Colonel Clowry was duly elected.

The California Electrical Society held a meeting in the Murphy Building, San Francisco, Cal., Monday evening of last week. President Keith stated that he had been promised $100 of the $200 to be raised by subscription for the purchase of a library. Specimens of wire to be used in the electric light system of the cruiser San Francisco were exhibited, and viewed with interest. The evening was passed in the discussion of self-induction.

Telephone Quotations.—Col. S. G. Lynch, broker, 153 Monroe street, Chicago, furnishes quotations on telephone stocks as follows:

Chicago	$298@$300	Cumberland	$ 59@ $60
Central Union	67@ 68	Wisconsin	116@ 117
Michigan	98@ 99	Bell of Missouri	140@ 145
Great Southern	30@ 32	Iowa Union	21@ 23
Colorado	38@ 40	Missouri and Kansas	54@ 55
Rocky Mountain Bell	40@ 45		

ELECTRIC LIGHT STOCKS.

Chicago Arc Light and Power	$104@$105	Chicago Edison Co	$125@$130

Going to the Convention.—The Electrical Supply Company, Chicago, will be there with flying colors, red, white and blue. Mr. John P. Barrett's smiling countenance and hearty grasp of the hand will be there and every one will join in wishing him a hearty success. Mr. Harry Small of the Thomson-Houston Chicago offices intends to live in the water most of the time he remains at Cape May. Dr. Gilbert M. Smith, western manager of the Alphabet Company, will probaby be at Cape May to look after the health of the fair invalids. Mr. W. G. Halm, vice-president of the Perkins Electric Lamp Company, Hartford, Conn, will endeavor to stop cutting coupons for a day or two in order to meet his friends at the Stockton. Mr. James R. Dee, the peninsular prince of power and light and telephony will probably come down from the picturesque country in the far north and tell the members about that profitable base ball club. Mr. H. S. Winston, president of the Illinois Electric Material Company, Chicago, will be a "tenderfoot" among the boys, this being his first electrical convention. But don't take him for a "dead wire," for he made his "pile" hustling on the Chicago real estate board. The Western Power Construction Company, Chicago, will be represented by its able manager, Mr. Waldo P. Adams, who has made such an enviable record for enterprise and efficiency in securing more contracts within sixty days than are generally picked up in a year. Mr. P. L. Rose, manager of the Rose Electric Light Supply Company, and better known as "that second-hand man in St. Louis," has already secured rooms at the Stockton, and now it is rumored that he will endeavor to form a trust or combination, like all other successful and wealthy corporations. Will Father McGlynn go in? Mr. A. H. Bauer, chief electrician of the Pullman Company, will probably run into Cape May before the meeting adjourns. If so the delegates should question him in reference to "that new storage battery" which is said to give "an output of current twenty-five per cent. in excess of the amount required to charge the cell." Mr. C. A. Brown, manager of the Western Electric Company, of Chicago, will be on hand as usual to help along the good work, for since the formation of the association, way back in '85, Mr. Brown has ever been a leader in all that tended to advance and strengthen the best interests of the organization. Capt. Myron Alexander Knapp, manager of the Knapp Electrical Works, Chicago, will join the crowd at Cape May, and is primed full of stories, guaranteed to cure any case of "the blues." Captain Knapp will be at home on the water, too, for he commanded the largest steamer on the lakes when just of age. Mr. Charles Wirt, the electrician of the Electrical Supply Company, Chicago, will be located at the Stockton, and will there illustrate the value and use of the Wirt voltmeter, the Wirt lighting arrester and other specialties that his company is placing on the market. As Mr. Wirt was formerly connected with the Edison Standardizing Bureau, superintendents of stations desirous of gaining information respecting the best methods of using testing instruments should form his acquaintance. F. Del.

SOUTHERN NOTES.

Norfolk, Va., Aug. 16, 1890.

Brenham (Tex.) capitalists are organizing a $10,000 electric company.

Cardiff, Tenn.—A telephone line has been erected between Cardiff and Clossville, also lines to Rockwood and Harriman.

Another Electric Railway Signal.—E. C. Wiley is endeavoring to organize at Bristol, Tenn., a company to manufacture the electric railway signal recently patented by him.

A Strong Company.—At Newport, Ky., the C. R. Smith Plating Company with $2,500,000 capital stock has been incorporated by C. W. Mackey, W. H. Forbes, Philip Engels Kuger and others.

Johnson City, Tenn.—A. M. Young, representing the Thomson-Houston Electric Company, is reported to have been recently given a contract to build and equip the new electric street railway.

New Orleans, La.—The officers of the recently incorporated Electrical Safety Railway Switch Company Ltd. are: E. B. Wheelock, president; T. N. Miles, vice-president, and R. W. Bringhurst, secretary.

The newspapers of Richmond, Va., are strenuously advocating that city's owning an electric light plant. It is urged that steps be taken at once to bring this plan into execution, as the contract with the Schuyler company expires early next year.

A Mining Plant.—One of the first electric mining plants erected in West Virginia has just been put up by the Thurmond Coal Company at its mines in Fayette County. The plant will cost over $20,000, and will consist of lights as well as mining machinery. The dynamos will be of 350 ampères capacity.

An Atlanta Electrical Inventor Dead.—Mr. Laurence Westerland, a prominent electrical genius of Atlanta, Ga., died in that city a few days ago He was the inventor of an underground electric railway system that has been regarded by electrical experts as being remarkably practicable. Mr. Westerland was a native of Sweden, was about 40 years of age.

New Orleans, La.—The Crescent City Street Railway has become an electric road, and the new cars began operating recently. The electric batteries and motors were all made in New Orleans by the Electric Traction and Manufacturing Company and these were put into the cars after they arrived from the manufacturers. The plant of this company is operated altogether by electric power.

The Louisiana Electric Light Company of New Orleans is preparing to enlarge its plant, and will make a number of important improvements in its machinery. Its buildings are to be enlarged by the erection of an annex. The cost of these contemplated additions and improvements will reach as high a sum as $1,500,000, and the work will require a year in which to complete it.

The Telephone Business Growing at Norfolk.—The Southern Bell Telephone Company, of Norfolk and Portsmouth, in order to keep pace with its growing business, has found it necessary to put in an 800-wire multiple switch board, requiring the services of eight operators. This new board is of the latest design, and embodies all of the most recent improvements, and cost several thousand dollars.

Richmond, Va.—An effort is being made to form a company having for its object the inauguration in Richmond of the Gamewell Auxiliary Fire Alarm. The following well known business men of Richmond are among the subscribers for the stock: Messrs. John Pope, of Allen & Ginter; Dr. John Mahony, Joseph W. Laube, Police Commissioner; Col. John Murphy, James E. McKenney, attorney-at-law; Sol. Cohen, Charles H. Page, L. W. Pizzini, of W. D. Moser & Co., and others.

Augusta, Ga.—The new electric street railway will be bonded for $400,000, and the six per cent. securities will be floated in Europe. They will be placed there by the European representative of the syndicate that built the road. A title of the road and real estate of the company to the Metropolitan Trust Company, of New York, who will hold the property in trust for the bonds, was filed for record one day last week. The money that will be raised on the bonds will be used to further develop and improve the electric company's property.

A Telegrapher Caned.—Mr. William H. Sterling, late chief of the day operators of the Western Union Telegraph Company's Norfolk office, and who is now with the Virginia, Tennessee & Georgia Air Line, was a few days ago very pleasantly surprised by the receipt from the employés of the Western Union office, of an elegant ebony cane with a beautiful gold head, betokening their appreciation of him as an associate and as a telegrapher. It was accompanied by a letter couched in complimentary language, which will be appropriately responded to by Mr. Sterling, who feels highly honored at this recognition from his old associates.

A Police Signal System for Atlanta, Ga.—The Police Commissioners of Atlanta have long seen the imperative need of a police signal system in that city. The Commissioners therefore petitioned the Council to appropriate a sum for the purchase of the desired system. After some discussion on the part of the Council, this body referred the matter back to the Police Commissioners, with instructions to invite the different companies to send their agents to Atlanta and exhibit their respective systems, the Commissioners then to select the system which they deemed best suited to the city. The Municipal Signal Company, of Boston, Mass., was the first to respond, sending its agent, Mr. C. I. Skinner, with all the essential apparatus of this well-known electrical signal system. Mr. Skinner made arrangement for space on the top floor of the Atlanta station-house, and has put up a perfect and practical exhibition of his company's system for the inspection of the Commissioners. The Gamewell system and probably others are expected to be put up shortly for exhibition. Y. N. B.

ENGLISH NOTES.

(From our own correspondent.)

London, Aug. 9, 1890.

Sir William Thomson's New Voltmeter.—Sir William Thomson has just completed a new voltmeter, which is intended for use in central stations. Its action depends upon the repulsion of a movable coil supported on knife edges, the arrangement being a modification of his well-known balances. It is to be expected that this instrument will be as trustworthy as other valuable pieces of measuring apparatus which have been constructed under Sir William Thomson's guidance at Glasgow.

Railway Rates.—The railway companies have, under a new act of parliament dealing with railway and canal traffic, held prolonged negotiations with the Board of Trade, with the view of determining the classification of all kinds of merchandise and fixing maximum freight rates. A draft report has been issued by the Board of Trade, and in this the electrical industry appears to be well treated. Several concessions have been obtained, and more

than one definition of hitherto unclassified apparatus has been effected.

St. Pancras and the Electric Light.—The vestry of St. Pancras, which is a large district in the north of London, but not so important from an electric lighting point of view as the residential quarters and those which contain theatres, has determined to undertake its own lighting. It has consulted some of the leading experts, and an elaborate specification has been drawn up and tenders invited. The total sum to be expended is about £52,000, of which £900 is a royalty paid to Dr. Hopkinson for the use of the three-wire system. A sum of money has not yet been voted, but the matter is of considerable interest, as this is the first local authority in London to do its own lighting.

The Kensington Court Central Station.—This station was the first to get into regular working order in London. It was started in 1887 in the midst of a small district of new houses, and built upon the site of the magnificent palace, which Baron Grant had erected for himself, when at the height of his prosperity. It is the centre of a wealthy residential district, and Mr. Crompton exercised great judgment in the selection of this position, since the new roads have subways beneath them by which the wiring was easily effected. The lighting from the first has been very successful, and the battery system employed has given such a continuous and steady current that no less than 10 miles of mains are now supplying 19,000 lamps.

News of the Week.

THE TELEGRAPH.

New Line to the Pacific Coast.—The Western Union Telegraph Company will construct a new through wire from San Francisco, Cal., to Chicago. It will be put up over the Atlantic & Pacific line.

A Broken Cable.—The Western Union Company's cable between Fire Island and Babylon has parted, and ships consequently cannot be reported until they are sighted off Sandy Hook or the Highlands. The cable, which is between four and five miles long, frequently parts, but the water being comparatively shallow, it takes but a short time to repair it.

Liability of Telegraph Messenger Service.—The business of a messenger company being to carry parcels and deliver messages for a consideration, it becomes charged with the liabilities of a common carrier and when it undertook to deliver a team of horses and a carriage it was bound to know that the agent whom it employed to make the delivery was able to handle the team; and it is liable for damages resulting from a runaway while in the custody of the messenger. *American District Telegraph Co. v. Walker*, Court of Appeals of Maryland.

THE TELEPHONE.

Increase of Subscribers.—The Cleveland division of the Erie Telegraph and Telephone Company made a net gain of 20 subscribers in the month of July.

Underground Work.—A Baltimore dispatch says that the Bell Telephone Company is finishing its system of underground wires at that place at a cost of $2,000,000.

A Humane Suggestion.—A New York physician suggests that telephones be placed on the islands in the bay used for hospitals for infectious diseases, where the unfortunate patients are more isolated than convicts, and where an occasional conversation with a friend or relative on shore, without danger of infection, would be an inestimable boon. There might be a profit in the investment.

THE ELECTRIC LIGHT.

Hickman, Ky.—Parties are talking of an electric light company.

Shelbina, Mo.—The town has voted to issue $5,000 bonds for an electric light plant.

Meyersdale, Pa.—An electric light plant will be established by a home company.

Ennis, Texas, is to have an electric light plant, and the contract has been awarded.

Palmyra, Mo.—The Palmyra Light and Water Company has been incorporated.

Las Vegas, N. M.—The Las Vegas Electric Light Company will establish a plant at that place.

Verona, Pa.—The Verona and Oakmont Light, Heat and Power Company has been incorporated.

Windsor Locks, Conn.—The Edison company is to put an electric light plant into the factory of C. H. Dexter & Sons.

New Bedford, Mass.—Subscription papers for the stock of a co-operative electric light company are being circulated.

Mt. Pleasant, Mich.—The Edison Electric Light and Power Company has been incorporated with a capital of $10,000.

Selma, Ala.—The Selma Electric Light and Gas Company will, it is reported, erect an incandescent electric light plant.

Mammoth Springs, Ark.—The erection of an electric light plant is projected. E. L. Hutchinson can give information.

Mt. Sterling, Ky.—The Mt. Sterling Electric Light Company has made the city a proposition to erect an electric light plant.

Fort Payne, Ala.—An additional dynamo is being added to the plant of the Fort Payne Electric Light and Power Company.

More Light.—At the demand of Opelika citizens, that Alabama town has recently erected a number of extra electric lights.

Buckhannon, W. Va.—The Buckhannon Electric Light Company has been incorporated to furnish electric light, heat and power.

Morrilton, Ark.—W. J. Stowers, M. D. Shelby, W. D. Delong and others have received a charter to erect an electric light plant.

Brockton, Mass.—It is said that the Edison Illuminating Company will build a five-story brick and stone building, to cost $40,000.

Exeter, N. H.—The Thomson-Houston Electric Company has arranged for the immediate establishment of an electric lighting plant.

Naval Lighting Plant.—The old frigate. "Lancaster," now repairing at the Portsmouth navy yard, is to have electric lighting plant.

The Electric Light and Power Company, of Evansville, Ind., has added a 50 arc Fuller-Wood and a 1,000 light Slattery alternator to its plant.

Willamette, Ore.—The Falls Electric Light Company will increase the capacity of its plant by the addition of 1,500 incandescent and 100 arc lights.

Greensborough, Ala.—C. A. Waller, A. H. Benners, Charles Stollenweick and others have organized a stock company to erect an electric light plant.

Lexington, Ky.—The electric light plant now being erected by the Belt Land Company will be operated by the Central Electric Company shortly to be organized.

Portland, Ore.—A duplicate of the Lenox Lyceum electric light tower is to be placed in the centre of the Music Hall at the Portland Exposition.

Humboldt, Tenn., and Marion, N. C., are both desirous of having electric lights, and parties in each place are organizing a company to erect the necessary plant.

An isolated electric light plant is reported to be in process of erection at the paper mill of the Piedmont Pulp and Paper Company, Piedmont, W. Va.

Bristol, Conn.—The Bristol Electric Light Company proposes, when its new equipments are completed, to furnish incandescent electric lights for a cent an hour per light.

West Hoboken, N. J.—The Union Hill Electric Light Company has petitioned for a franchise to place poles in the streets. A franchise has already been given the Hudson Electric Light Company.

Transfer Agent.—The New England Trust Company will hereafter act as transfer agent of the Westinghouse Electric and Manufacturing Company. Hitherto transfers have had to be made at Pittsburgh.

Clyde, N. Y.—The Clyde Electric Light and Power Company has been incorporated, with a capital stock of $32,500, for the purpose of establishing an electric light system. Chas. H. Ford is interested.

Abilene, Kan.—The Mosher Arc Lamp Company, has been incorporated, with a capital stock of $50,000. Incorporators—J. A. Mosher, S. C. Mosher, W. S. Hodge and Theodore Mosher, of Abilene, and H. E. Rogers.

New Westminster, B. C.—A. M. Herring and others propose starting an electric light company, with $50,000 capital stock. The company intends to use the water power of the Brunette River for operating its plant.

Somerville, Mass.—Owing to the growing demand for electric motors for operating machinery, etc., the Somerville Electric Light Company contemplates changes that will enable it to furnish this service to all who may wish it.

Chicago, Ill.—Prof. Barrett will soon place electric lights in that section of the South Side lying between the river and Twenty-second street. The power-house is being built on Fourteenth street and Indiana avenue.

Oswego, N. Y.—At a meeting of the directors of the Oswego Gas and Home Electric Light Company recently it was decided to remove the electric light plant to the High Dam, where arrangements have been made for securing 600 horse power.

Bloomington, Ill.—A rumor prevails that there is to be a rival gas company in Bloomington, and that it is to be promoted by the Fort Wayne Electric Company, because the Citizens' Gas Company has gone extensively into electric illumination.

Burlington, Vt.—The Thomson-Houston Electric Light Company is putting in a 1,300 incandescent light dynamo. This will give it a capacity for 2,600 incandescent and 100 arc lights. The engine power will soon be increased and electric motors will be added.

Trustees Elected.—The directors of the Municipal Electric Light Company, of Brooklyn, N. Y., have unanimously elected the following trustees: Matthew Dean, Edgar Holliday, James L. Jensen, Clement Lockitt, John Hills, Bernard Gallagher and Edward G. Graff.

Napa, Cal.—At a meeting of the board of trustees a resolution was made and adopted to accept the bid of the Thomson-Houston Electric Light Company, for arc lighting, which was as follows: 24 arc lights, 1,200 c. p., until 1 A. M., $10 each; 24 arc lights, 1,200 c. p., all night, $15 each.

Media, Pa., seems to thoroughly appreciate the electric light. The Media Electric Light, Heat and Power Company has a 1,500 light Westinghouse alternate current plant, and is now ordering an additional 500 light machine with a view to keeping up with the demands of its customers.

Springfield, O.—The common council has recently let the contract for 100 arc lights of 2,000 c. p. to the Thomson-Houston Electric Light Company at $100 each per annum; lights to shine from half an hour after sunset to one hour before sunrise every night in the year, with deductions for lost time pro rata.

Pittsburgh Theatre Lighting.—Mr. Charles L. Davis, Esq., known to theatrical fame as "Alvin Joslin," is going to build a theatre in Pittsburgh. Mr. Davis intends to rely upon electricity as an illuminant, and has made a contract with the Edison people to install their system in his establishment.

The Gloucester (Mass.) City Electric Light Company, at its annual meeting elected the following officers: Philip H. Fowler, president; Charles H. Fowler, secretary and treasurer; Frank A. Fowler, superintendent; directors, William J. Thompson, G. A. Muller and Frank A. Fowler.

Double Arc Lamp Patents.—A telegram from Cleveland, O., says that on the final hearing at Toledo the Court has filed an opinion in the Brush double carbon lamp case against the Western Electric Company, sustaining the Brush patent, granting an injunction, and ordering an accounting for infringement.

Seattle, Wash.—John H. McGraw has been appointed president, and T. H. Tyndale treasurer of the Seattle General Electric Company. C. A. Spofford, representing Henry Villard, has arranged to issue $300,000 of the stock to enlarge and improve the plant recently acquired from the Seattle Electric Light Company.

Moorestown, N. J.—The Moorestown Electric Light Company has found it necessary to add another boiler to its battery, to operate the increasing number of lights. A tubular boiler of 135 h. p. has been ordered, and a new issue of stock authorized to cover the expense. It will also be necessary at an early day to add another dynamo and engine to the present plant.

Rockport, Ind.—The electric light plant at Rockport was started Aug. 1, with over 200 16 c. p. lamps and 300 more contracted for. The plant consists of a 600 light Brush alternator, driven by a 60 h. p. Ball tandem compound engine. It is operated by the Water Company, which uses the same boiler for pumping during the day and for the electric light at night.

San Francisco, Cal.—The Edison Company is to make an electric light exhibition at the Mechanics' Institute Fair. There will be a pillar of light similar to that exhibited at the Lenox Lyceum, in New York, to be placed on the main floor of the pavilion, opposite the entrance. It will be 20 feet high and will rest on a base six feet high. The piece will cost $1,200.

Mr. C. M. Blanchard, is engineering the electrical construction at the Kenilworth Inn, Asheville, N. C., where there are to be 1,000 lights. He is also fitting up the Bryn Mawr Hotel for 3,000 lights at Bryn Mawr, Pa., and has just completed the incandescent wiring of the private house on Spring Garden street, of Prof. E. J. Houston, of the Thomson-Houston Electric Company.

Falls City, Neb.—This city will shortly have its Brush alternating incandescent system in operation, and desires to receive prices and circulars of materials such as oil filters, lamp shades, rosettes, cord, wire, tools, line testers and the like. Address Alfred Minnick, superintendent, who writes us that all communications will receive his personal and careful attention.

Allentown, Pa.—The Allentown Electric Light and Power Company, which for some time has been using the Westinghouse alternate current system of incandescent lighting, has just placed an order with the Westinghouse Company for another machine it being found necessary to increase the capacity of the plant to 2,000 lights.

Winona, Minn.—The committee of the Winona council, to which was referred the bids for lighting the city has reported in favor of the Winona Electric Light Company, on its bid for $96 per light per year for 100 lights, the contract to run for five years. The lights are to be of 2,000 c. p. and are to be lighted by the Philadelphia schedule.

Change of Position.—Mr. R. A. Smith, first engineer of the Uniontown (Pa.) Electric Light and Power Company, has resigned his position and gone to Dunbar, Pa., to work in the machine works of the Dunbar Furnace Company. Mr. Fred. Harrison, formerly with the North American Construction Company, has taken the position temporarily.

A New Superintendent.—The directors of the Scottdale (Pa.) Electric Light and Power Company met on Monday and accepted the resignation of Superintendent S. C. Stevenson, and elected Joe McIlvaine as his successor. Mr. Stevenson was compelled to resign on account of other pressing business duties. Albert Loucks was elected assistant superintendent of the plant.

Brockport, N. Y.—At a meeting of the Brockport Electric Light Company, the following officers were elected: President, R. J. Cook; secretary, H. N. Beach; treasurer, D. C. Freeman; directors, John Owens and J. D. Burns. This re-election of officers was necessary by the sale of the Morgan stock in the plant to the Thomson-Houston Company, which now owns a controlling interest in the stock.

In All the States but One.—The Westinghouse alternate current incandescent system is being employed for central station lighting in every State and Territory of the Union with the exceptions of the State of Nevada and the Territory of Arizona. In the State of Texas 20 lighting companies have seen fit to adopt the Westinghouse system. In Pennsylvania the Westinghouse stations number very nearly 40.

Electric Light Decorations.—One of the most prominent features of the dedication of "Ellsworth Park," by the G. A. R., at Scottdale, Pa., last week, was the number of arc and incandescent lamps that were placed in the grove, suspended from the trees, and intermingled with the vines and shrubbery. At night the Park was more brilliant and attractive than during the day, and reminded one of some vast conservatory more than a G. A. R. encampment.

, Mont.—Work has been commenced on the new plant of the Butte Electric Light Company. The buildings will be placed near the Butte Reduction Works, and will be built to meet the requirements of the business. A new plant has been ordered, and a portion of it is already on the way from the factory. It is intended to have it one of the most complete systems in the West when finished, and it is estimated will cost about $100,000.

Evansville, Ind.—The new addition to the Evansville gas and electric light station is well under way. It will be 50 feet wide by 175 feet long, built of brick, with slate roof, with brick stack 125 feet in height, and will have four boilers 72 inches by 18 feet, and a 400 h. p. Lane-Bodley Corliss engine. There has been added another 1,200 16 c. p. Brush alternator, which will be started in a few days The present capacity is 4,000 incandescent and 300 arc lights.

Looking Backwards.—A meeting of electric light people in Chicago was held on the evening of Feb. 4, at the Grand Pacific Hotel, to take the initiative with regard to the "electric light convention," about which there has been some little talk lately. The meeting was presided over by Mr. C. A. Brown, of the Western Electric Company, and officers and committees were appointed. . . . —*Editorial in* THE ELECTRICAL WORLD, *Feb.* 7, 1885.

Middleboro, Mass.—The electric lighting question appears to be at least partly settled. The Middleboro Electric Light and Power Company will soon go out of existence, giving way to the company which is known as the Middleboro Gas and Electric Company. The company is capitalized at $130,000 to furnish gas and electric lighting to Middleboro at rates not definitely determined upon as yet, but approximating at 80 cents per light per month for incandescent electric lights and gas at about $5 per 1,000 feet.

Three Cities Lighted in Georgia.—When the spirit of progress strikes a town it is not long content without an electric light plant. Electric illumination is deemed a necessity wherever commercial activity is found. The South, as everybody knows, is developing rapidly at the present time, and consequently in that region there is large demand for electric lighting apparatus. The Westinghouse Electric and Manufacturing Company has recently closed contracts for plants in three Georgia towns, Valdosta, Washington and Waycross. It is evident that the Empire State of the South is determined not to be distanced by its sisters.

The Electric Light on the Lakes.—A fortnight ago we noted that Mr. S. D. Nesmith, of Cleveland, O., had placed a search light on the steamer "Progress," and last week we spoke of similar plants on the "Maryland" and the "Emily P. Weed." The "Progress" has found the search light of immense value, and it is said to shorten her time by five hours each trip. Mr. Nesmith has now placed two arc lights on the boat, to be used in loading and unloading at Escanaba and Ashtabula, and a further large saving of time is expected from this improvement. The "Progress" is well named.

Grass Valley, Cal.—John Glasson, superintendent of the electric light company, has requested a renewal of the contract for street lighting at the expiration of the present term, about three months hence. There are now 14 street lights and another has been ordered for lower Mill street. This Mr. Glasson will maintain without extra cost, the 15 lights under the new contract to be paid for at the rate of $116.65 per month, the sum now paid for the 14 lights maintained. Additional lights are to be maintained for

per month. The term for which the new contract is asked is for from three to five years.

Substitution of Electric Lighting for Gas Lighting.—In an action by a taxpayer to restrain municipal authorities from substituting electric lights for gas lights in a certain street, allegations that the erection of poles for electric lighting would impair the value of the land along the street; that the contract price was exorbitant; that the cost would be much greater than that of gas lighting; that the change would render useless many gas lamps owned by the city, and that gas lighting was desired by a majority of taxpayers on the street, are sufficient to warrant granting relief to the taxpayer, though the municipal authorities have full control of the subject of street lighting. This decision was rendered in the case of Talcott vs. City of Buffalo, Supreme Court of New York.

Kansas City by Electric Light.—Kansas City is fast becoming one of the best lighted cities in the West. In addition to a half dozen electric light companies who furnish arc and incandescent lights as well as electric power, there are not less than 30 isolated lighting plants owned by private individuals. One of the most complete and perfect of the latter will undoubtedly be the one in the mammoth dry goods house now about completed for Bullene, Moore, Emery & Co. The system of electric lighting used will be the improved Westinghouse, using both incandescent and arc lights. The contract for the electric work was awarded about ten days ago, and the engine contracts were let the past week to the well-known engineering firm of English, Morse & Co., of Kansas City. There will be two engines of the celebrated "Ide" pattern, having a combined capacity of 200 h. p. They will be fitted with all the latest improvements to give the highest attainable results. A special feature will be Hill clutch pulleys fitted to each engine shaft, and so arranged that part of the dynamos can be stopped at will without the necessity of stopping the engines. Connections will also be made from either engine to an automatic exhaust fan, which operates pneumatic tubes throughout the entire building for handling cash from the various counters.

APPLICATIONS OF POWER.

Covington, Ky.—The Covington Street Railroad Company is considering the adoption of electricity as a motive power.

Memphis, Tenn.—Robinson & Brickly, of St. Louis, Mo., have the contract for constructing the Memphis electrical railroad.

Little Rock, Ark.—The Little Rock and Argenta Railway Company has asked permission to operate its lines by electricity.

Knoxville, Tenn.—The Black Diamond Coal Company proposes to adopt electric locomotives in its mines for the purpose of conveying coal.

Seattle, Wash.—The West Street and North End Electric Railway has been granted a franchise to construct and operate a single or double track railway.

White Plains, N. Y.—The Board of Trustees has extended the franchise for the building of the Port Chester, White Plains and Tarrytown Electric Railroad until Sept. 15.

Waco, Tex.—The Citizens' Railway Company has purchased the Waco Street Railway and is converting it into an electrical railroad. George Clark can give information.

Golden, Colo., is to be connected with Berkeley by an electric road. Surveyors have been at work on the line for some weeks. The capital needed is said to come from Connecticut.

Lynchburg, Va.—The West Lynchburg Land Company is said to have let the contract to the American Development Company for converting its street railroad into an electrical railroad.

Beatrice, Neb., is one of the newest places to make use of electricity for motive power. It is said that the railway line will be in operation in 60 days after the plans and specifications are drawn up.

Chattanooga, Tenn.—The Electric Street Railroad Company have finished their line to St. Elmo and are now operating it. They have recently given their order for an additional dynamo and engine.

Portland, Ore.—The Transcontinental street car line sent an order East for the first installment of material for an electric plant and system for their road. The plan is to change the entire system into an electric line.

The Mill and Mine Electric Equipment Company, Pittsburgh, Pa., has increased its capital from $10,000 to $100,000 and is now in a position to develop the various special applications of electricity to the mill and mine.

The Connecticut Motor Company has just completed two new combination electric motors and blowers for the new United States cruisers "Concord" and "Bennington," now nearly completed in the Cramps' ship yard,

Raleigh, N. C.—It is stated that a syndicate is negotiating for the purchase of the street railways of Raleigh, N. C., and if the negotiations terminate favorably, as they are likely to do, the present mule power will be displaced for an electric system.

Washington, Pa.—The Washington Electric Street Railway Company, which has heretofore been in the hands of outside capitalists, has been purchased by local people. The men who have done the buying are said to mean business. Electricity will be used as a motive power for the cars.

Atlanta, Ga.—The committee on electrical construction of the city council held a meeting last week, and considered a new ordinance requiring all telephone wires to be placed underground by or before 1893. There was opposition to the proposed measure, but it was finally decided to report it favorably.

Denver Street Railway.—The South Division of Capitol Hill line is about completed. The road bed is done, the wires are strung and the machinery at the power house is all in shape. The motor cars have arrived and as soon as the attachments are put in, the road will be started, probably this week or next.

Greensburg, Pa.—The Electric Street Railway Company is getting into shape rapidly for building its lines. There will be some moderately heavy grades on the proposed line, and it is said that the kind of motor has not been decided on, though a number of the members of the company are in favor of the Sprague equipment.

The Troy Hill Electric Railway Company is the latest street railway organization in Allegheny. It wishes to make it easy for the residents of the hill top, the name of which it bears, to reach their places of abode. Rights have been asked for from the city council. The new road will depend upon electricity as a motive power.

No Change of Motors.—A Pittsburgh paper says that the local officials of the Edison company have made a denial of the statement that the Sprague motors were to be taken off the Pleasant Valley road, and replaced by the Westinghouse motors. They say the Sprague motors will remain on the road and that no change whatever is contemplated.

Life Guard for Electric Cars.—Mr. W. Y. Brady, of Pittsburgh, has invented a contrivance which he calls "the adjustable life saving guard for street cars." The principle of the invention is a series of pliable bars, covered with leather and resting on iron shoes, which, when lowered, will run close to the ground and receive any impediment, human or otherwise, which the car may strike. It is claimed that this device would render accidents less serious and often save life.

The Duquesne Traction Company is a big corporation, backed by wealth and political influence, which is constructing a long street railway line from the heart of Pittsburgh to various portions of the East End suburbs. This combany has a big field in Pittsburgh, but, if we may believe reports, it longs for a larger domain. It is making overtures to the two large Allegheny street car companies, the Pittsburgh, Allegheny and Manchester and the Pleasant Valley, to come under its wing. It is not settled that the Alleghenians will avail themselves of the offer to consolidate, as they are said to be in a pretty independent position, and each has a fine district to itself.

St. Louis, Mo.—George D. Capen, President of the Lindell Railway Company, has submitted to the Board of Public Improvements his plans for erecting poles and wires for the electrical equipment of the Lindell Railroad. The ordinance governing the same authorizes him to erect the poles either in the middle of the streets between the tracks or on the sidewalks—as done by the Scullin lines. It is the intention to the company to use both methods on its line. On Washington avenue, between Third and Seventeenth streets, the poles will be placed in the middle of the street. Beyond that point for some distance the poles will be fixed in the sidewalk, while out in the western suburbs the poles will be placed between the tracks.

Richmond, Va.—The capital city of the Old Dominion is considerably stirred up over the petition of a proposed company to the city council for the privilege of constructing an electric street railway on Grace, Cary, and other prominent streets. Grace street is the street of churches in Richmond, and some of the various congregations on that thoroughfare do not want their religious worship disturbed. Last Sunday at the Grace Street Baptist Church resolutions protesting against granting this franchise were adopted unanimously, and a committee was appointed, with instructions from the church, to oppose the laying of the road on that street, and to memorialize the Committee on Streets of the City Council to prevent its construction. Another committee was appointed to secure the co-operation of other churches on the street in preventing the line from being built.

The Enterprise Light, Power and Heat Company was organized at McKeesport, Pa., a few days ago, and will erect a brick central station at Reynoldton, one of McKeesport's close neighbors, in the near future. The officers of the new company are J. E. White, president; Thomas Reynolds, treasurer; L. G. Reiber, secretary, and H. H. Swaney, solicitor. A company has also been organized, with a capital of $120,000 to build a street railway from Reynoldton to McKeesport. Interested in this latter company is Politician William Flinn, of Pittsburgh. Several other Pittsburghers have joined Mr. Flinn in the venture. Reynoldton lies across the Youghiogheny River from McKeesport and as many of the mill workers employed at the huge plant of the National Tube Works Company live at Reynoldton, a rapid transit line between the two towns ought to be the reverse of a losing organization.

The Pittsburgh & Birmingham Traction Company is busily engaged in the erection of a fine structure at the corner of Carson and Thirtieth streets, Pittsburgh, Pa., to serve as a power house. The building will be of brick with stone trimmings and of a pleasing style of architecture. The general manager of the company, Mr. Verner, is now in the East buying the engines and other equipment for the power house. An overhead electric system will be used. As yet no decision has been made as to which one of the various systems in the market will be adopted. The road will be so constructed that it will be an easy matter to make a change to the storage battery should that system be adopted. The boiler house, immediately in the rear of the power house, will be 116 × 50 feet, and behind it will be located the machine shop in size 100 × 100 feet. Beside the machine shop will be built a coal shed 50 × 100 feet. Gas, however, will be used for fuel; the provision for coal is with an emergency in view. To the left of the power house will be erected a very large car shed. The offices of the company will be placed in front of the car shed, on either side of the entrance and will be nicely fitted up. The Pittsburgh and Birmingham Company is said to have a great future before it and, judging from the careful preparations made, seems to fully recognize the pleasing fact.

MISCELLANEOUS NOTES.

A Pittsburgh Strike.—Two thousand five hundred machinists and skilled mechanics struck last week at Pittsburgh, Pa., for nine hours for a day's labor, with ten hours' pay. About 1,800 of the strikers are employed by the Westinghouse Electric and Manufacturing Company and the Westinghouse Machine Company.

An Important Patent Sale.—The United States patents, covering the Widdefield-Bowman automatic electric brake system for freight trains, covered also by patents in Canada, Great Britain, India, Russia, Italy, Spain, Germany, Austria, Hungary and Belgium, were recently sold to the Westinghouse Air Brake Company, of Pittsburgh. The system, and a test of the same on the Lehigh Valley Railroad, were fully described in THE ELECTRICAL WORLD in 1889. Edward P. Thompson, of New York, was interested in the patents as one of the selling agents, and served as attorney in obtaining the United States and foreign patents.

PERSONALS.

Mr. F. W. Nicholson has become the secretary and general selling agent of the Canada Electric Company, Ltd., of Amherst, N. S., vice J. H. Wagstaff, resigned.

Mr. J. T. Bradbury, of Lowell, Mass., was in town last week. Mr. Bradbury's new system of storage batteries, for which the patent has now been allowed, is attracting a good deal of attention, and a company is now organizing for their manufacture and sale. Among those interested in the company are Mayor Crawford, of Lawrence, Mass., Mr. Frank Stone, and A. W. Robinson, of Boston. Mr. Bradbury had just returned from a successful business trip to Chicago.

Mr. Charles Cooper has resigned the presidency of the Municipal Electric Light Company, of Brooklyn, N. Y. He has been succeeded by Matthew Dean, and Edward G. Graff has been made secretary in place of Robert Payne. Mr. Cooper was formerly president of both the Citizens' and the Municipal companies, and was active in carrying forward the work of introducing lighting by electricity in the city. He is now connected with the Brooklyn Electric Light and Power Company.

Industrial and Trade Notes.

The Wheeler Reflector Company, of Boston, reports large shipments of its reflectors to electrical companies in the West.

The Tripp Manufacturing Company is receiving a large number of orders from the West for the new electric truck which it has just placed in the market.

The Eureka Door Bell Company at 86 Beverly street, Boston, is meeting with great success, introducing its non-electric "Daisy" bells Nos. 5 and 6. This bell is especially adapted to bicycles.

A sample of Simplex wire recently taken from a mine in the Lake Superior region was in a perfect state of preservation after lying for months 500 feet underground with a stream of water constantly running over the wire.

The Jordan Train Lighting Company is receiving large orders for its train lighting apparatus and "Duralite" goods. This company's new "Best" trolley wire holder is also being used extensively on Massachusetts electric railways.

Mr. H. A. Rogers, of 19 John street, New York City, is doing a good business in manufacturers', machinists' and electrical supplies of all kinds. Mr. Rogers is a hard worker and fully deserves the large and prosperous business he has worked up.

Messrs. High Bros. & Co., of 123 North Third street, Philadelphia, have taken the agency for the Ironsides motor manufactured by Mr. N. H. Edgerton. These motors are well constructed, sell at a low figure, and the demand for them is steadily increasing.

W. H. Gordon & Co. report an active business in general supplies, especially of Simplex insulated wire for which they are New York agents. The great success of this firm is due to its energy and earnest effort to furnish exactly the kind of goods the trade demands.

The Rhode Island Telephone and Electric Company, of Providence, is doing a splendid business with its "Little Giant" carbon battery, and has lately begun to export it to South America. The Wright cable clip, manufactured by the same company, is also receiving a very ready sale.

The New York Electrical Manufacturing Company, 10 West Twenty-third street, this city, has shipped 60 motors, of all sizes, during the past week, to all parts of the country. This company has an order from the Perfection Switch Company for 50,000 single-pole, 10-ampère porcelain switches.

The Redstone Electric Company, of Uniontown, Pa., has taken some very good orders for house furnishings, and has contracted with the Schoonmaker Coke Company to fit up one of its most important mines with electric signals. To the latter branch of the business this company pays considerable attention.

The Armington & Sims Company, which has been working its factory three evenings a week for the last five years, and has made constant additions, has been compelled by the rush of work to employ two sets of men, and on Aug. 11 began to run from 7 o'clock Monday morning to Saturday noon without a stop—24 hours a day.

The new Root water tube boiler, manufactured by the Abendroth & Root Manufacturing Company, 28 Cliff street, New York City, continues to grow in public favor. Several of these boilers are doing good service in electric lighting stations, where their safety qualities, economy of fuel, and general efficiency make them especially desirable.

The Globe Electric Cordage Works, of Philadelphia, are manufacturing a flexible cord which is claimed to be absolutely fire, water, and moisture proof. This cord has been put to a very rigid test by Mr. McDevitt, Chief Inspector of the Board of Fire Underwriters Association of Philadelphia, and by large electric supply and lighting companies.

Managers of electric light and power stations seem to have taken a fancy to the Davidson steam pump, manufactured by M. T. Davidson, 43-53 Keap street, Brooklyn, N. Y., for we notice that the number of them in use for such service is increasing daily. The Davidson pump has many admirers, too, among general manufacturers and mining men.

The Sperry Electric Company, Chicago, is sending out a circular calling attention to their "triple carbon lamp" which is proving a success wherever tried. This special device can be easily fitted to old lamps of any make at small cost, and, having but one carbon rod, it is claimed that it can be operated and maintained at a less cost than double lamps.

The Weston Electrical Instrument Company, of Newark, N. J., is putting the finishing touches on its new factory, and the four principal floors, with their splendid array of fine tools, make an imposing appearance. Superintendent Britton is delighted with his new charge, and promises the most accurate and finest finished ammeters and voltmeters in the world.

Chadbourne, Hazleton & Co. are furnishing to Wm. Sellers & Co., five 5 h. p. Wenstrom motors, and one 8 h. p., to be used on traveling cranes that they are building for the Baldwin Locomotive Works. These motors have self-oiling bearings and large armatures, and are of very slow speed for the size of machine. They are to be delivered the first of October.

Wm. Sellers & Co. have in their shops two Sprague motors which were installed by the Equitable Electric Railway Construction Company, one of 15 h. p., driving a blacksmith shop, and the other of 10 h. p., used as a portable motor for testing and temporarily driving new machinery. These electric motors have been very convenient and satisfactory for this work.

Charles A. Schieren & Co., of No 47 Ferry street, New York City, have turned out over 1,000,000 feet of their belts up to date, and are still enlarging their output. These belts have varied from two to 70 inches in width, but most of them were for dynamos, and were between six and 12 inches. Since their patents were issued, covering the perforated belts, the value of the Schieren belt has increased, and the firm is constantly receiving testimonials from users of its products.

The Standard Underground Cable Company, of Pittsburgh, is not complaining about lack of business. It recently received from Minneapolis a $25,000 order for wire, and a $50,000 order from the metropolis came into their net. The Standard Underground people say that in Cleveland an effort is being made to abolish overhead electric light, telephone and telegraph wires, but that in other cities the question of underground work does not seem to be commanding great attention just at present.

Messrs. James J. Murray & Co., of Philadelphia, have been increasing their capacity and making extensive improvements at

their factory. They are in full operation for the season of 1890 and 1891, and are producing many new designs in glass goods for both arc and incandescent lighting that are very popular with the trade They wish to extend an invitation to the many electric light friends who will necessarially visit Philadelphia during the Cape May convention, to call at their works on Trenton avenue.

The Electrical Supply Company, 171 Randolph street, Chicago, is pushing the sale of its specialties: shield brand moisture-proof wire, the Sunbeam incandescent lamp, Wirt voltmeter, and Wirt lightning arrester, Ajax dry battery, Habirshaw wires, cables and cores, and interior electrical conduits. The demand for these high class goods even during the quiet season, has been far in advance of the highest expectations, necessitating the employment of increased help and a greater storing capacity.

The Knapp Electrical Works, 54 and 56 Franklin street, Chicago, have prepared for an unusually heavy fall trade and now have several car loads of Grimshaw wires and cables, weatherproof wire, magnet wire, etc., on hand ready for immediate shipment. Then they have great rows of barrels filled—not with apples—but with the Perkins celebrated incandescent lamp. And they will soon have as big a stock of Knapp needle annunciators on hand as they had before the fire, when orders for a hundred a day could easily have been shipped.

The Magnolia Anti-Friction Metal Company, of 74 Cortlandt St., New York, have received a gratifying testimonial from the Western Light and Power Company, of Chicago, stating that since the adoption of the Magnolia bearings a great deal of the heating that had previously been a source of trouble on a 100 h. p. engine had been obviated. The manager of the Chicago company, Mr. W. M. Talcott, adds: "We have had the most excellent results from the use of your Magnolia metal, and could not ask for better service: we trust that this report will be explicit and pleasing to you."

The E. P. Gleason Manufacturing Company, 181-189 Mercer street, this city, manufactures a great variety of electrical glassware, arc and incandescent lamp shades, etc. The company will start up its glass factory next week with a full equipment of men. Extensive improvements have just been completed at the factory that will be for the benefit of the company's customers. This company also manufactures gas and electric light fixtures. A great variety of special fittings for fixtures are made, and the company manufactures to order all kinds of metal specialties, particularly those adapted to the incandescent system.

Magnolia Metal.—A report of a recent trial of the United States cruisers says: "On the shaft bearings magnolia metal is being used. This is a form of white metal which was found on the trial of the Charleston and Yorktown to be absolutely necessary to the life of the bearings. White metal is very similar in composition to type metal. A depth of one-eighth of an inch of white metal will be exposed in all the shaft bearings of cruisers Nos. 9 and 10." Under severe duty, running at excessive speeds, and overloaded, it is said that this metal shows no evidences of strain or excessive heating, a fact that makes it extremely valuable in the construction of war ships.

Queen & Co., of Philadelphia, report a steady and increasing demand for their specialties in test instruments. Their improved portable testing sets are meeting well deserved favor, as new features of great value to electricians have been introduced. These sets are being made in large quantities to fill orders already received. The new magnetic vane ammeters and voltmeters, as brought out by the same firm, are much sought after, and are now in use by the Edison, Brush, and Mather companies. Queen & Co. will send a large collection of instruments to Cape May for the convention, and all who are interested in the subject will be well repaid by a visit to their parlor.

The National Water Tube Boiler Company, of New Brunswick, N. J., is very busy on large orders for their boilers, and has found it necessary to increase its facilities to keep pace with the rapidly growing business. The company has recently added an extension to its works, and is putting in additional machinery, which will greatly facilitate deliveries. The "National" boilers are now in use in almost every State in the Union, and in many foreign countries. The splendid plant of about 600 h. p. of these boilers, lately erected for the Sawyer-Man Electric Company, in Twenty-third street, New York, is a novel one, combining in its construction the best results of advanced mechanical practice.

The Eureka Tempered Copper Company, of North East, Pa., has received the following analysis of its tempered copper, from Dr. F. A. Genth, chemist, of 111 South Tenth street, Philadelphia:

	1 Pig copper.	2 Edge pieces.	3 Castings.
Silver	0.096	0.053	0.095 per cent.
Copper	99.890	99.961	99.914 per cent.
Tin	trace	0.045	0.094 per cent.
Lead	trace	trace	trace
Iron	0.056	0.069	0.056 per cent.
	100.042	100.128	100.159 per cent.

Consolidation of Interests.—A recent consolidation of interests is announced in the absorption of the New England Electric Supply Company by the Bryant Electric Company, of Bridgeport, Conn. This latter company, organized under Connecticut State laws with a full paid capital of $100,000, has the following well-known gentlemen as its directory: H. T. Clark, president; W. C. Bryant, treasurer; J. C. English, secretary; P. H. Alexander and J. M. Orford. It is already well in the front rank with its specialities, among which is the well-known Bryant double-pole switch, said to be the only switch in the market which with one motion breaks the circuit at four points.

The Evans Friction Cone Company is about to install the power plant for the Juniata shops of the Pennsylvania Railroad. It will consist of two Westinghouse 45-light alternating arc machines and two United States incandescent machines of 400 lights each. The two arc machines are to be driven from an 85 h. p. compound Westinghouse engine, and each of the incandescents is driven by a 45 h. p. compound Westinghouse. Each dynamo will be driven by the Evans friction cone, and there will not be an ordinary belt in the station. The Evans Company is getting out a special catalogue for the Cape May Convention. Five large blue prints are bound in, each one showing some of the largest stations fitted. This company has installed over 1,800 h. p since March of this year.

A New Pamphlet.—Those of our readers who visit the Cape May convention this week may be interested in knowing that the Interior Conduit and Insulation Company will issue a pamphlet of testimonials of the interior conduit system similar to the one issued some time ago. The title page will read: Indorsements of the interior conduit system by the leading electric light companies, wiring contractors, insurance inspectors, boards of fire underwriters, architects and builders. The pamphlet will contain fac-simile letters from J. Pierpont Morgan, E. H. Johnson, Thomas A. Edison and Elihu Thomson, besides indorsements as announced on the title page. It will be quite an interesting book, and will be given away to those who visit the company's exhibit at the Cape May convention.

The Connecticut Motor Company, of Plantsville, Conn., whose office in New York is at 127 Fifth avenue, has issued a handsome circular and catalogue combined, containing well-made cuts of its excellent motors and some interesting facts and data concerning the use of electric motors in general, as well as valuable notes and tables by Albion T. Snell. The testimonials received by the company, as reprinted here, are of a most flattering character, and come from Boston, Hartford, New Haven and New Bedford. The F. C. Cannon Manufacturing Company says: "We have used your motors exclusively on our elevator work, and have them running in various parts of the State. Have never had or been obliged to make any adjustments or repairs after starting them. Of course we are well pleased with this record."

Answers to Correspondents.

Questions to be answered in this column must be of general electrical interest, and must be accompanied by real name and address as a guarantee of good faith. No notice will be taken of questions regarding apparatus unless enough details are given to permit a definite answer, and no dynamo or motor designing will be done.

The Current is Too Weak.—What is the probable trouble with a battery wire where you can taste the current, and yet it will not register on Warner's gauge or ring a bell? G. A. L.

Simply the current is not strong enough. A very weak current can be distinctly tasted, as can be easily shown by taking a silver coin and a bit of zinc, pinching them together at one end and putting the tongue between the passage ends.

Electrocution—Is there any good authority for the word "electrocution," which I see that most of the newspapers have been using very frequently with reference to the execution of Kemmler? It apparently is not correctly formed, being derived from one Latin and one Greek word. SUBSCRIBER.

About the only authority for "electrocution" is newspaper usage. It is, as you say, a word of barbarous formation. If any special word is necessary to denote death by electricity "electrothanasia" is the proper medical term to employ, and you will observe that the term was used by Dr. Shrady in his comments on the execution, as published in last issue of THE ELECTRICAL WORLD.

A Dynamo in Trouble.—I have made an eight-light dynamo according to the descriptions in the *Scientific American Supplement*, and have followed directions as nearly as possible. When the armature was wound incorrectly it worked pretty well as a motor, but with the armature wound according to directions it will not work at all, even when run 2,228 turns per minute as a dynamo. The armature is now properly wound and everything seems correct. The fields were cast of hard stove iron. Can you tell me what is the probable difficulty? W. C. H.

Such questions as these are very difficult to answer properly without an experimental investigation of the machine. It may be that you have made a mistake in connecting the armature or in connecting the field coils. You would not get good results in any case from a dynamo of which the field magnets were made of hard cast iron. When cast iron is used for this purpose it is the softest obtainable and carefully annealed. It is possible that in re-winding the armature, as you have apparently done, you have formed a short circuit somewhere about the machine. At all events you would do well to test for a short circuit between adjacent commutator segments or between commutator segments and frames of the machine and to look over the winding carefully to see that everything is in the right direction.

Dynamo Designing.—For a dynamo, Manchester pattern, shunt wound, of fifty 16 c. p. incandescent 100-volt lamps capacity, field magnets to be round soft iron laid into the base, and yoke of cast iron, please give the following facts: What should be the diameter and length of field magnets, the size of magnet wire, number of convolutions per layer and number of layers? Also, what should be the size of armature core without insulation, the size of the wire and number of wires per layer; also number of layers for armature winding, and number of coils or sections to armature? L. F. P.

If you will look at the head of this column you will find a certain statement to the effect that no dynamo or motor designing will be done. The statement was made for the reason that many of our friends send in inquiries that are the proper business of a professional electrical engineer and require a large amount of valuable time to work out. If the above questions had been sent to an electrical expert he would probably have taken a day or two for the work and sent in a bill of anywhere from $25 to $100. We would suggest that you get S. P. Thompson's "Dynamo-Electric Machinery" or Carl Hering's book on the same subject and work out the problem for yourself. You would not find it very difficult, although somewhat tedious, and you would gain a large amount of valuable information that will stand you in good stead hereafter.

The Electrical "Current."—We see from a clipping in the New York *Sun* that Dr. Louis Duncan has recently expressed certain new views about electric currents in which we have considerable interest. We are at a loss to understand quite what he means, and if there is anything in his theory—which we must confess is new—we would consider it a valuable favor if you would devote space toward spreading his views. Has Dr. Duncan any followers? M. M. H.

The views referred to in the *Sun*, as expressed by Dr. Duncan, are those held at this time by nearly all advanced electrical thinkers. The fundamental idea is that a wire carrying a current or what we call a current does not serve as a conductor in the same sense that a pipe serves to conduct water, but rather is a nucleus around and in which an electro-magnetic disturbance is propagated. The idea that we must look outside the wire in considering the mechanism of an electric current is not at all new, and was the subject of an interesting discussion by Mr. Poynting some years ago. One need only look at a transformer to get a very vivid idea of the way in which electricity is not confined to the wire said to conduct it, for in this case nearly the whole energy of the current transmitted is spent outside of the wire which was once supposed to confine it. These phenomena of induction make it quite evident that the new view has much common sense on its side, and the theory of the somewhat complicated actions has been sufficiently worked out to enable us to say that any theory of the transmission of an electric current which considers only the electrical disturbance that takes place in the so-called conductor is diametrically opposed both to modern theory and to experimental facts. The idea is convenient in discussing certain classes of electrical phenomena, and reasoning based upon it is not necessarily incorrect, although it takes account of only a part of the facts.

Business Notices.

The Battery Cut-Out sold by the Electric Supply Company of Syracuse, N. Y., 105 South Warren street, is cheap. Thoroughly tested, it is giving complete satisfaction. It automatically prevents the short-circuiting and damaging of gas lighting and other batteries. Send for circular.

The Litofuge Manufacturing Company, New York City.

GENTLEMEN: During the past year, while superintendent of the Spanish-American Light and Power Company in the city of Havana, Cuba, which electric plant consists of 4,500 incandescent lamps and 600 arcs, with four 15 h. p. Hazleton boilers, owing to the water in that city used for the boilers containing a large per cent. of magnesia and other substances, I was much troubled with the scale that formed on tubes and plates, causing considerable expense for labor to clean the boilers. Since using your compounds, both A and B, the result has been very satisfactory, the boilers now simply requiring washing, and the mud taken out in the usual way. I made careful examination of the plates to see if they had become pitted in any way, but could not detect the slightest ill-effect. I shall not hesitate in recommending your compounds where water is at all impure.

Yours very truly,

(Signed) WILFRID H. FLEMING,
Member Institute Electrical Engineers.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

U. S. PATENTS ISSUED AUGUST 12, 1890.

433,948. Electric Conductor Terminal; Charles A. Lieb, of New York, N. Y. Application filed May 5, 1890. The invention consists in forming in the end piece, or "coupler" of the terminal, a hole having two diameters, one of them large enough to receive insulated wire or wires, and the other of such size as to receive the end of the wires after the insulating material has been removed.

433,959. Signal; William C. Paul and Oscar D. Kleinstuber, of Milwaukee, Wis., Assignors, by mesne assignments of one-third to Charles E. Paul. Application filed January 28, 1889. In a signal, the combination, with a gear train communicating with electro magnet through a single cam wheel and a bifurcated armature pawl, the respective arms of which pawl engage in a catch upon the respective sides of the cam wheel, of a wrist wheel, a link, a reciprocating standard, and a day and night signal connected with and operated by said reciprocating standard.

433,981. Telephone; Edward Davis, of Cambridge, Mass., Assignor of one-half to E. B. Welch, of same place. Application filed Nov. 19, 1885. Renewed Feb. 14, 1887. The invention consists in the combination with the main line of a telephone circuit, an induction coil, the secondary of which is included herein, of a reinforcing apparatus consisting of a polarized electromagnet included in the main line, two diaphragms separated by a space containing powdered carbon or other variable resistance, one of said diaphragms being in close proximity to the electromagnet, and a primary circuit comprising a battery, the primary of the induction coil, and the two diaphragms, the arrangement being such that the said reinforcing apparatus intensifies or strengthens the sound transmitted over the line at the receiving telephone, said apparatus being also capable of being used as an electric telephone for transmitting or receiving articulate sounds.

434,017. Method of Welding Metals by Electricity; Herbert E. Fowler, of New Haven, Conn., Assignor of one-half to D. T. Hedges, of Sioux City, Iowa. Application filed November 15, 1889. The method of welding by the aid of electricity, which consists in holding the parts to be welded in contact and causing an electric current to traverse the joint, then cutting off the electric current and applying external heat to complete the welding.

434,024. Electro-Therapeutic Appliance; Gustav Monrath and William M. Gibbons, of Chicago, Ill., Assignors, by direct and mesne assignments to said Gibbons and Charles C. Bateson, of same place. Application filed December 3, 1887. An article for electro-therapeutical purposes, consisting of a fabric composed of cotton, silk or other material suitable for non-conducting purposes, provided with conductors of electricity, suitably arranged in connection therewith, the conductors being alternately connected with conductors adapted to be connected, respectively, with the opposite poles of a battery.

434,030. Electric Railway; Rudolph M. Hunter, of Philadelphia, Pa., Assignor by mesne assignments to the Thomson-Houston Electric Company, of Boston, Mass. Application filed Oct. 4, 1886. The combination of the rails and their supports with a slotted conduit, ties to hold said conduit at a fixed distance with reference to the rails, and one or more bared electrical conductors contained within the conduit, insulated from it and supported parallel with the slot, whereby said conductor or conductors are guarded from injury and from short circuiting.

434,032. Ammeter and Voltmeter; Gustav Pfannkuche, of New York, N. Y. Assigner to the Brush Electric Company, of same place. Application filed May 5, 1886. An ammeter or voltmeter comprising a pivoted holder containing mercury, electrical means for displacing said mercury, and means whereby the position of the holder is adjusted progressively in correspondence with the displacement of said mercury.

434,034. Support for Car Motors; Sidney H. Short, of Cleveland, O. Application filed April 1, 1890. In combination with the wheel base of an electrically propelled car or vehicle, and the motor for propelling said car or vehicle, the new and improved means for supporting the said motor and gearing its armature to the driving wheels without establishing an electrical connection therewith, said means comprising a support between the field magnet and the driving axle, provided with a journal bearing for the axle, but being electrically disconnected from the same, and also comprising transmitting gear electrically disconnected from said axle.

434,036. Trolley for Electric Railways; Joseph H. Wehrle, of Newark, N. J. Application filed October 9, 1889. The combination with a spring supported plate having ducts for electrical wires or cables therein, of trolley wheels running in chambered boxes of non-metallic insulating material.

434,076. Underground Electric Conduit; Franz Gottlieb Christian Zopke, of Berlin, Germany. Application filed December 21, 1889. An underground conduit for electric wires, composed of two sections, each provided in its inner face with a

series of longitudinal grooves, which when united form channels for receiving the conductors, the ridges between the groove being provided with longitudinal ribs, and the ends of the sections being provided with ribs.

434,087. Electric Rail-Connector; Charles A. Lieb, of New York, N. Y. Application filed May 5, 1890. The invention consists in making terminals or pins which enter the rails integral, or practically so, with the connecting wire or bar, which extends from one to the other.

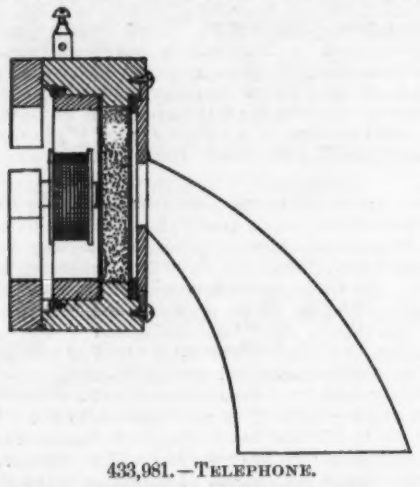
434,093. Secondary Battery; Paul Schoop, of Zurich, Switzerland. Application filed March 14, 1890. As a plate for a storage battery, a central rod with a series of arms thereon, and a series of thin plates secured on such arms and lying substantially parallel with the axis of the rod.

434,096. Rotating Part of Dynamos and Motors; Elmer A. Sperry, of Chicago, Ill., Assignor to Sperry Electric Company, of Illinois. Application filed Sept. 9, 1889. In a revolving portion for a dynamo or motor, which is subjected to sudden or concussive strains, the body of the armature made up of disks, combined with longitudinal insulations running the entire length of side desks for the purrose of holding same more firmly together, said insulations consisting of rawhide.

434,133. Method of Apparatus for Burning Holes in Metal; William P. Kookogey, of Brooklyn, N. Y. Assignor to the Kookogey Electric Co., Application filed April 25 1890. An apparatus for burning holes in comparatively fusible material, consisting of a tool or punch capable of heating under the electric current, a source of electrical energy capable of supplying energy adapted to heat the punch and having terminals bridged by the punch, the punch forming part of and completing the circuit between the terminals.

434,144. Electrical Insulator; John K. Dunbar, of Austin, Texas. Application filed February 6, 1890. The invention consists in a clamp or wire holder made of a doubly slotted flanged plate, forming a pair of opposing jaws with a wire seat between them and a wedge adapted to pass through the slot and secure the wire.

434,147. Electric Railway; Rudolph M. Hunter, of Philadelphia, Pa., assignor to the Electric Car Company, of America, of same place. Application filed April 11, 1890. The combination, in an electrically propelled vehicle, of a vehicle body supported



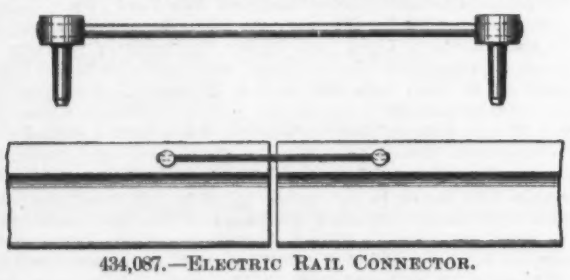
433,981.—TELEPHONE.

upon the axle by means of springs, a frame journaled upon the axle independently of the vehicle body, a stationary armature rotating field magnet, and motor shaft secured to and carried by said frame, and a mechanical connection between the motor shaft and the axle to which the frame is journaled.

434,148. Electrically Propelled Vehicle; Rudolph M. Hunter, of Philadelphia, Pa., assignor to the Thomson-Houston, Electric Company, of Connecticut. Application filed July 16, 1890. In an electrically propelled vehicle, the combination of a shaft geared to the axles, two sets of armature coils and their commutators carried by said shaft, and means to magnetize both of said sets of armature coils simultaneously.

434,149. Cut-out and Connection for Electrical Apparatus; Charles J. Klein, of New York, N. Y. Application filed June 6, 1890. An electrical coupling consisting of a principal part having a cylinder cavity and provided with electrodes and notches extending across the opening of said cavity, and a secondary part made in the form of a disk; having notches which enable it to be passed beyond the electrodes into the cavity of the principle part and having metallic contact pieces which may by rotating this secondary part be made to bear against the said electrodes.

434,152. Switch for Electric Circuits; Philip Lange, of Pittsburgh, Pa., Assignor to the Westinghouse Electric Company, of same place. Application filed Sept. 1, 1887. Patented in England May 29, 1888; in Belgium May 29, 1888; in Italy May 29, 1888;



434,087.—ELECTRIC RAIL CONNECTOR.

and in France May 29, 1888. The invention relates to the construction of switches for controlling the circuit connections of dynamo electric generators delivering currents of high potential.

434,153. Incandescent Lamp Socket; Philip Lange, of Pittsburgh, Pa., Assignor to the Westinghouse Electric Company, of same place. Application filed Oct. 31, 1888. In a key socket, the combination, with a base, of a base plate contained therein, screws passing through the sides of the base holding said base plate in position, lugs carried by the base through which said screws pass, and a recess in the base plate fitting over the lugs.

434,154. Electric Indicator; Phillip Lange, of Pittsburgh, Pa. Assignor to the Westinghouse Electric Co., of same place. Application filed May 15, 1890. In an electric indicator, a solenoid and a core therefor, consisting of sections of magnetizable material, said sections being of such length and separated such distance that several sections may be contained within the core at any time and a rigid rod upon which the sections are supported apart from each other in a longitudinal series.

434,159. Incandescent Electric Lamps; Albert L. Reiman, of Allegheny. Assignor to the Westinghouse Electric Co., of Pittsburgh, Pa. Application filed November 14, 1889. In a lamp bottom, the combination of a shell and bottom plate of insulating material, said shell having a groove formed in its edge for receiving a leading-in wire.

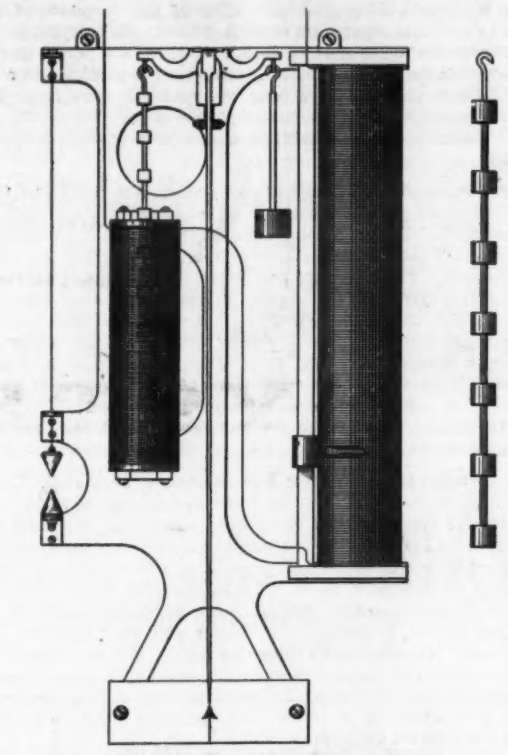
434,163. Protector for Electric Machines; Lewis B. Stillwell, of Pittsburgh, Pa., Assignor to the Westinghouse Electric Company, of same place. Application filed Sept. 2, 1889. The combination, with a lightning arrester, of a differentially wound reactive coil, through both coils of which the initial current may flow, and means for interrupting the connections through one of said coils by an abnormal flow of current there through.

434,164. Core for Electrical Apparatus; Charles A. Terry, of Pittsburgh, Pa., Assignor to the Westinghouse Electric Company, of same place. Application filed June 28, 1889. A core plate for electric converters, consisting of a sheet of soft iron having one or more openings formed therein for receiving the converter coils, and having its edges and surfaces coated by oxide of iron, and having one or more cuts transverse to the magnetic circuit of the plate, the edges of such cuts being bare.

434,165. Subway for Electric Conductors; George Westinghouse, Pittsburgh, Pa. Application filed March 15, 1890. In a ventilated subway, the combination of a vault, a lid therefor having ventilating openings, a water shed or drain about the said lid, a receiving basin with which the water shed communicates and an air duct extending from above said lid to the external air.

434,166. Electric Arc Interrupter; Alexander Wurts, of Pittsburgh, Pa., Assignor to the Westinghouse Electric Company, of same place. Application filed Dec. 7, 1889. The invention consists in providing a normally interrupted path to the earth, across which the lightning discharge passes and interposing an apparatus which will be brought into operation by the flow of current through that path to momentarily provide a closed circuit around the normally open or interrupted circuit.

434,167. Lightning Arrester; Alexander Wurts, of Pittsburgh, Pa. Assignor to the Westinghouse Electric Company, of same place. Application filed January 16, 1890. In a lightning arrester for electric circuits, the combination of lightning discharge plates and two electrodes in series therewith in the earth



434,154.—ELECTRIC INDICATOR.

circuit, resting normally in contact but seperable on the passage of a discharge through the same and returnable thereafter to normal position, whereby the arc formed by said discharge is broken and the circuit restored.

434,168. Safety Fuse for Electric Circuits; Alexander Wurts, of Pittsburgh, Pa., Assignor to the Westinghouse Electric Company, of same place. Application filed. The combination of a lead or alloy fuse for electric circuits having a given melting point and a fuse of a higher melting point connected therewith.

434,169. Electric Safety Fuse Box; Alexander Wurts, of Pittsburgh, Pa., Assignor to the Westinghouse Electric Company, of same place. Application filed May 12, 1890. The combination, with a safety fuse, of an inclosing box or chamber therefor, having a hollow space for containing air, and vents in its walls through which the ends of the fuse extend.

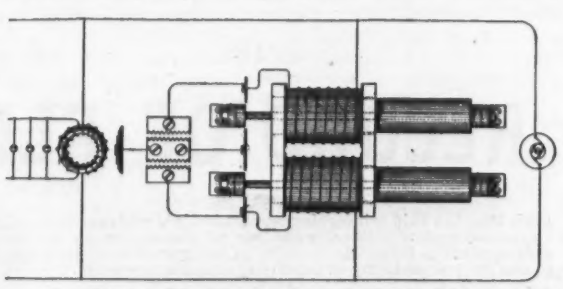
434,170. Lightning Arrester; Alexander Wurts, of Pittsburgh, Pa., Assignor to the Westinghouse Electric Company, of same place. Application filed May 15, 1890. The invention consists in providing a normally broken path to the earth for one or both sides of the main line circuit and in increasing the distance between the electrodes or terminals at the interrupted portion of the circuit by reason of the lightning discharge, and then causing the heat developed by the generated current passing across this space to still further increase the separation of the electrodes until the arc is completely interrupted.

434,175. Electric Arc Lamp; William E. Cady, of Corry, Pa. Application filed March 27, 1890. In a double carbon lamp, the combination, with clamps for lifting the carbon; of a rock shaft having arms projecting from it at different angles, one under each clamp, a lever secured to the rock shaft, a stop-dog also connected to the rock shaft, a magnet for releasing the stop-dog, and a spring for rocking the shaft in one direction.

434,180. Electric Motor; Theodore M. Foote, of Boston, Mass. Application filed July 18, 1889. A cylindrical field magnet composed of two semi-cylindrical sections, arc shaped pole pieces within said cylinder at opposite sides thereof and covering the joints between the semi-cylindrical sections, and bolts passing through the adjacent ends of said sections into the pole pieces.

434,186. Ceiling Block; William E. Jacques and George R. Emmett, of Attleborough, Assignor to Herbert C. Wirt, of Boston, Mass. Application filed Dec. 3, 1889. A rosette cut out consisting of a base provided with clamps to secure the circuit wires, having a T-shaped post on one side and an L-shaped post on the opposite side, a rosette provided on one side with a curved slotted contact plate and on the opposite side with a curved contact plate provided with a spring arm constructed to secure the rosette to the base by a wiping frictional spring contact.

434,199. Connector for Secondary Batteries; James K. Pumpelly, of Chicago, Ill., Assignor to D'Estaing S. Covert, of same place. Application filed March 19, 1889. The combination, with storage batteries, each having a series of electrodes, and one at least of the batteries having its uppermost electrode provided



434,166.—ELECTRIC ARC INTERRUPTER.

with an integral lug, screw thread on its exterior; of a connector for the batteries, comprising a flexible cable and a hollow sleeve loosely surrounding one end of the cable and having its interior threaded to adapt it for threaded connection with the threaded lug.

434,224. Secondary Battery; Henry Woodward, of Toronto, Canada. Application filed April 11, 1890. The invention consists in forming each electrode of cylindrical or otherwise shaped perforated tubes made of vulcanized rubber or other acid proof non-conducting material, the said tubes being passed through one or more holders or separators made of acid proof non-conducting material by which they are held at a fixed distance apart.

434,261. Printing Telegraph; Theodore M. Foote, of Boston, Mass., Assignor of one-half to Charles J. Pillsbury, of same place. Application filed July 27, 1889. In an electrically controlled printing apparatus operated by alternating currents sent over two independent circuits, the combination, with a double type-wheel, of a laterally movable rotary support therefor, a scape-wheel, rotating with the type-wheel, an electrically oscillated escapement adapted to control the revolutions of said scape-wheel and of its shaft, two electro-magnets in the same circuit, and an armature lever arranged between the magnets and connected with the rotary and laterally movable support for the type-wheel.

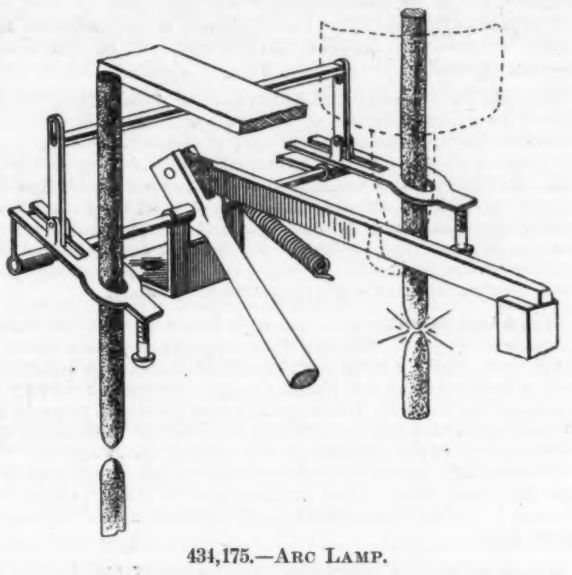
434,275. Electric Railway; Rudolph M. Hunter, of Philadelphia, Pa., Assignor to the Thomson-Houston Electric Company, Connecticut. Application filed September 11, 1889. The object of this invention is to supply electric current preferably from a common source, to two sets of line conductors extending along the tracks of a railway or railways, and from said conductors deliver the current to the motors of electrically propelled vehicles in multiple or parallel relation on the respective railways or tracks.

434,276. Current Collecting Device for Electric Cars; Rudolph M. Hunter, of Philadelphia, Pa. Application filed Dec. 17, 1889. The combination of an overhead conductor, a traveling car, an upwardly extending collector arm having a contact device at its upper end running against the under surface of the conductor and hinged at its lower end on a transverse axis permanently fixed to the car, and a spring to hold the upwardly extending arm in an inclined position so as to trail backward to the movement of the car.

434,301. Method of Making Electrodes for Secondary Batteries; Paul Schoop, of Zurich, Switzerland. Application filed March 10, 1890. The method of producing or manufacturing electrodes for secondary batteries, which consists in the deposition of mercury upon the lead plates forming the body of the electrodes, whereby an amalgam of lead and mercury is formed upon the surface of the lead electrode, and subsequently dissolving out the mercury so as to leave a spongy surface.

434,363. System of Transporting by Electricity in Mines; Elmer A. Sperry, of Chicago, Ill., Assignor to the Sperry Electric Company, of Illinois. Application filed April 12, 1889. In an electric tram car provided with rotating portions, the combination of a cable reel, a brake operated from the tension of the cable upon the reel and a variable friction device connected with the rotating portion of the tram car.

434,371. Lightning Arrester; Alexander Wurts, of Pittsburgh, Pa. Assignor to the Westinghouse Electric Company, of same place. Application filed May 12, 1890. The combination,

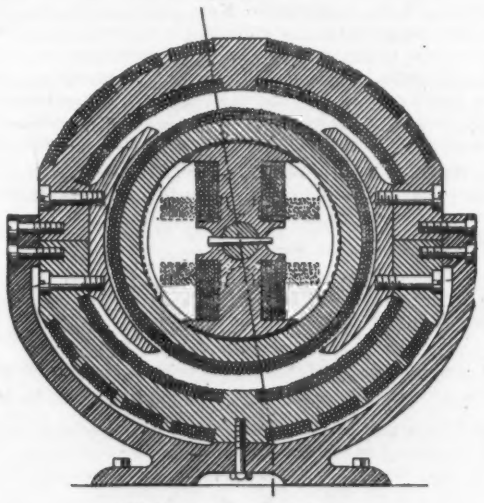


434,175.—ARC LAMP.

with an inclosing box or chamber, of two separated electrodes constituting discharge points for electric currents, the one being movable with reference to the other and projecting through an opening in the box or chamber.

434,376. Secondary Battery; George Whiteman Cochran, of New York, N. Y., Assignor of one-half to Benjamin Franklin of same place. Application filed Dec. 14, 1889. The invention consists in a cell formed of a series of concentric chambers having perforated walls and adapted to contain the active material. It also consists in the combination, with the concentric cells, of perforated spacing blocks or bars of insulating material placed between the walls of the cells to hold the parts in their relative positions.

434,382. Electro-Magnetic Clutch; Stanley C. C. Currie, of Philadelphia, Pa., Assignor by by mesne assignments to the United Gas Improvement Company, of same place. Application



434,180.—ELECTRIC MOTOR.

filed May 16, 1890. The combination, of a driven shaft or mechanism, the clutch magnet consisting of a central core and an exterior cylindrical core slightly longer than the central core, with the coil located between them, the armature, and the shaft or driven mechanism.

434,389. Electric Railway; Rudolph M. Hunter, of Philadelphia, Pa., Assignor to the Thomson-Houston Electric Company, of Connecticut. Application filed May 22, 1889. The combination of a car truck with a frame supported by the axles, two or more electric motors supported upon the frame, a shaft common to the armatures of said motors, and connecting devices between the armature shaft and axles of the car, whereby the rotation of the armature shaft may propel the car; a slotted conduit containing working conductors.

434,390. Electric Railway; Rudolph M. Hunter, of Philadelphia, Pa. Application filed May 15, 1890. In an electric railway, a slotted conduit, a working conductor in said conduit, an electrically propelled vehicle, a collector truck independent of the vehicle wheels connected to said vehicle, and a current collecting device extending down from the truck through the slot and making contact with the conductor.

434,391. Electric Railway; Rudolph M. Hunter, of Philadelphia, Pa., Assignor to the Thomson-Houston Electric Company, of Conn. Application filed July 16, 1890. The combination of a railway, vehicle or car, an electric motor to propel the car, a line circuit extending along the railway, an electric friction brake, a brake circuit for connection with the line circuit, and switches for coupling the brake circuit with the armature or line.

434,410. Closed Conduit for Electric Conductors; Charles J. Van Depoele, of Lynn, Mass. Application filed Jan. 5, 1889. For description see page 116.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patents issued since 1886—can be had for 25 cents. Give the date and number of patent desired, and address The W. J. Johnston Co., Ltd., Times Building, N. Y.

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Armature Winder.—At once, Experienced armature winder. Best of references required. COLUMBIA ELECTRIC CO., 207 E. Fourth street, St. Paul, Minn.

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Salesman Wanted at once for Electrical supplies; only first-class men need apply. Northwest Thomson-Houston Electric Company, St. Paul, Minn.

Designs Wanted.—Designs for an accurate, reliable, simply constructed ammeter and voltmeter. Must be patentable. CHAS. P. LARNED, 61 Bulil Block, Detroit, Mich.

Draughtsmen Wanted.—Two first class draughtsmen familiar with electrical work. Address, stating experience and salary expected, THOMSON ELECTRIC WELDING CO., Lynn, Mass.

Situation Wanted.—By a First Class mechanical and electrical engineer, a position where brains and energy are required. Address DYNAMIC,
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General Agent wanted for North America by one of the largest manufacturers of carbon points in Germany. Applicants who are willing to keep an assortment on own account will be preferred. Offers, with references, address to F. 967, care of Rudolf Mosse, Nurnberg, Germany.

Situation wanted as superintendent of central station, by one who has had large experience in line construction; understands arc and incandescent work. Have been handling men for several years. Can give the best of references. Address J. M.,
Care The Electrical World, New York.

Department Manager Wanted.—Man to take charge of detail department of electrical factory. Must be a good mechanic and have had experience in managing men. Applications should state experience and salary expected. Address S. C.,
Care The Electrical World, New York.

Situation Wanted.—A young man who is a first-class model maker and mechanic, and has had three years' experience on experimental work, and six months on experimental electric motors, would like position with responsible party. Address "INVENTOR,"
Care The Electrical World, New York.

Situation Wanted.—A Practical Electrician, eight years with last firm, two years of which were spent in Europe, and who has connectious in every capital city, desires engagement. Moderate salary. Is a hustler. Highest references given. Address PRACTICAL ELECTRICIAN,
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Situation Wanted.—The advertiser, who has had practical experience in business department of electrical manufacturing, commercial lighting and electrical supplies—both in office and on the road—would like an engagement. Is a competent accountant and office manager—thoroughly posted od construction and the handling of men. Willing to go anywhere. Could enter upon duties at once. Address ENERGY,
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Manufactured by The CLARK ELECTRIC CO., 192 Broadway, New York.

THE SUNBEAM MAINTAINS ITS RATED CANDLE POWER.

QUALITY OF LIGHT, THE PERFECTION OF BEAUTY.

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The Sunbeam Incandescent Lamp Co., cor. Randolph & Canal Sts., Chicago.

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The Best Coating for Arc Lamps, Hoods, Towers, etc.,

And all work which needs protection from weather. It will also render wooden moldings and conduits impervious to moisture. It is absolutely odorless.

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Insulation Guaranteed wherever Used, Aerial, Underground or Submarine.

In a letter from the Inspector of the **Boston Fire Underwriters' Union**, under date of March 29, 1886, he says: "**A Thoroughly Reliable and Desirable Wire in every respect.**"

The rubber used in insulating our wires and cables is especially chemically prepared, and *is guaranteed to be waterproof*, and *will not deteriorate*, *oxidize* or *crack*, and will remain flexible in extreme cold weather, and is not affected by heat. The insulation is protected from mechanical injury by one or more braids, and the whole slicked with Clark's Patent Compound, which is water, oil, acid, and to a very great extent fireproof. *Our insulation will prove durable when all others fail.* We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph and Electric Lights from stock. Cables made to order.

We are now prepared to furnish our Clark Wire with a *White Outside Finish* for ceiling cleat work as well as our standard color.

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FOR RAILWAY AND MOTOR use, we make all sizes of stranded and flexible cables with Clark insulation. Wire Tables and price list will be furnished on application to

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Electric Light Plant, capacity 600 incandescent lamps. Exclusive franchise and contract with city. Dynamos and engine in first-class order. ZEPH CHAS. FELT, Storm Lake, Iowa.

United States Arc Dynamos.—5 50-light U. S. Arc Machines and 250 U. S. Double Carbon Arc Lamps, all in good repair and ready to operate. Address LITTLE, McDONALD & CO., 144 E. Seneca street, Buffalo, N. Y.

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Good second-hand Underwriters' wire American gauge; 20,000 feet No. 0, 14,000 feet No. 2, 7,000 feet No. 1. This copper wire made by the Benedict and Burnham Manufacturing Company, used three years for D. C. incandescent lighting and sold because of change to alternating apparatus. Wire used on main lines and neatly rolled up on reels. Will sell same cheap for cash; sample of wire sent on application. For further information apply to GEO. F. WERT, Treasurer, 191 Middle street, Portland, Me.

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MEDIUM SPEED, AUTOMATIC TYPE.

One left hand, 55 horse power.
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One self-contained, centre crank, 140 horse power.
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SINGLE SLIDE VALVE, THROTTLING TYPE.

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Four 12 horse power.
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One 55 horse power.

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One 50-light American dynamo, with regulator, and 50 single American lamps.
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Two 25-light Western electric dynamos, low tension with regulator, sliding base and 50 single, outside frame, lamps.
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One spare armature for 20-light American dynamo.
Two 20-light Sperry shunt wound low tension dynamos with single lamps.
Two 20-light U. S. shunt wound low tension dynamos, with rheostat and sliding base.
One 16-light Brush dynamo with 16 single lamps.
Two 10-light U. S. low tension shunt wound dynamos.
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One 10-light Excelsior dynamo with 10 single lamps.
One 6-light Van De poele dynamo, low tension, with six single lamds.

INCANDESCENT.

One 700-light shunt wound dynamo, 100 volts, 37 ampères.
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Two 200 light U. S. long distance shunt wound dynamos, 560 volts.
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One 150-light U. S. shunt wound dynamo, 70 volts.
Two 100-light U. S. shunt wound dynamos, long distance, 280 volts.

SPECIAL.

Two 25-light Excelsior armatures, new.
One 20-light American armature.
Thirty new style single U. S. lamps.
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Forty old style single U. S. lamps at $5.

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ALUMINUM, $2 PER POUND.

The Pittsburgh Reduction Company, 95 Fifth avenue, Pittsburgh, Pa., U. S. A., offer commercially pure aluminum at the following rates at Pittsburgh, Pa.:

Lots of 1,000 lbs. and over....$2.00 ₰ lb.
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Metal guaranteed to be equal in quality to the best metal manufactured by any other process.

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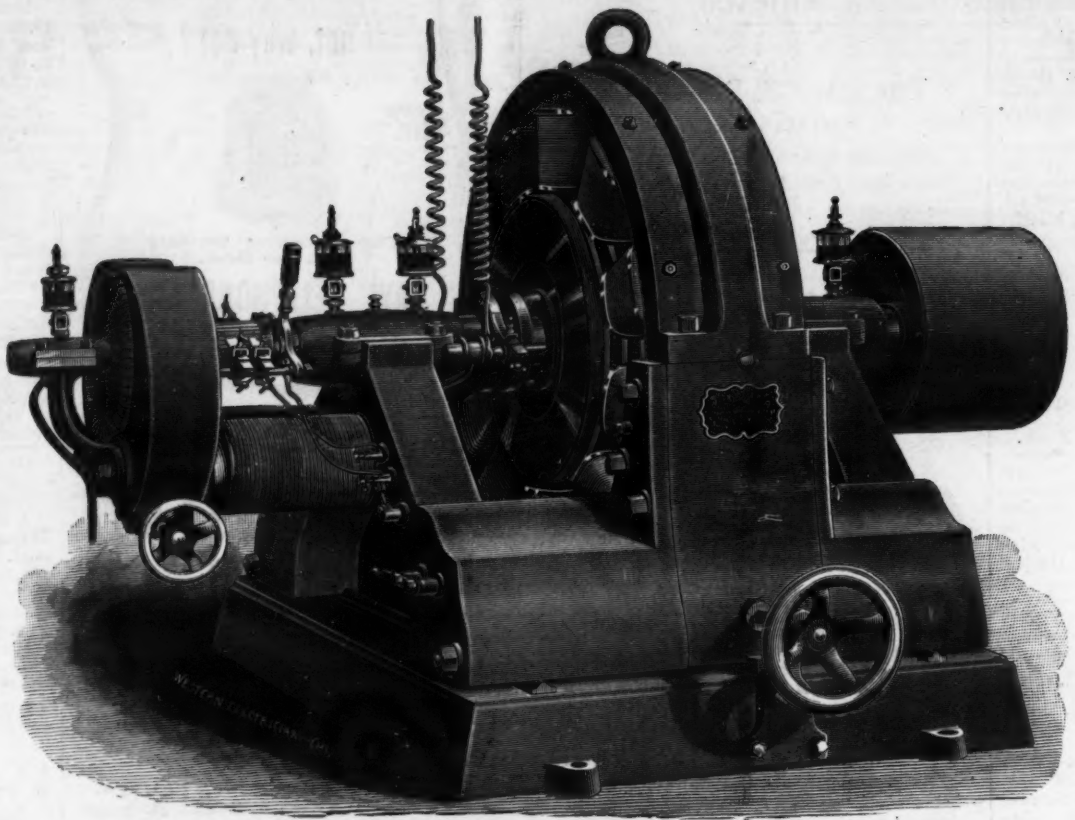
Complete Central Station Plants.



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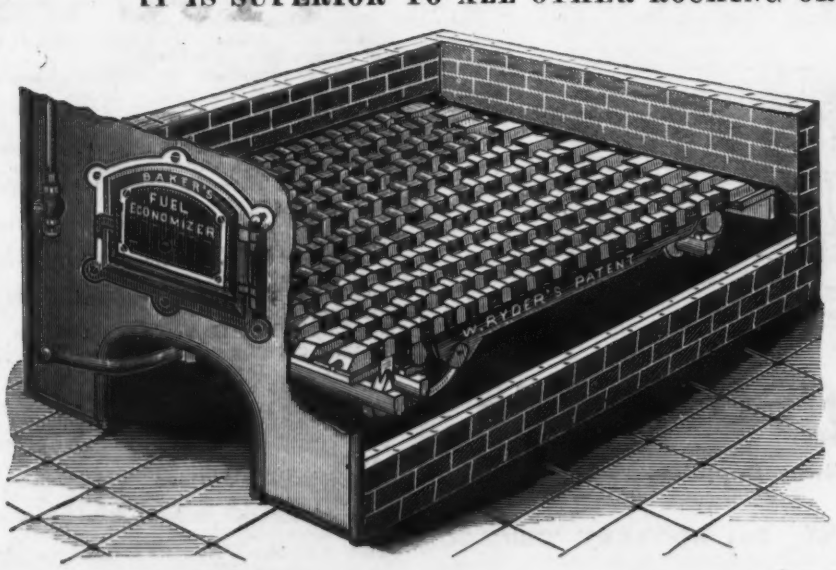
W. RYDER'S Patent Shaking Roller Grate.

IT IS SUPERIOR TO ALL OTHER ROCKING OR SHAKING GRATES FOR THE FOLLOWING REASONS:



1st. An eight-foot square furnace can be easily shaken with one hand, which cannot be done with any other bar.

2d. Four shakes with the lever will clean the worst kind of a fire, and can be done in less than one minute (and that, too, with the furnace door closed), thus preventing the cold air rushing in and cooling down the furnace and buckling and blistering the bottom of the boiler.

3d. Reason why it is superior to all other rocking or shaking grates, is simplicity in construction. It has no such big iron frame work in the ash-pit as seen in nearly all others, adding friction and complication and incumbering the ash-pit, thus rendering it very difficult to remove the ashes from the bottom pit.

4th. Reason why it is superior to any other is, it has no stationary or dead bar, nor stationary frame work lying next to the brick work to be filled up with clinkers, thereby diminishing or contracting the air space in the furnace, which is quite an important matter.

The four reasons in the above given for its superiority are combined in the construction of the **W. RYDER BAR** only, and in no other, and are of vast importance, as any good engineer can plainly see.

This grate precipitates all little clinkers between the bars, as well as dirt and ashes above the bars, giving a clear and free draft to every square inch in the furnace, and produces a saving from 10 to 15 per cent. of fuel. There are many parties who also claim great merits in their stationary bars, some of them patented. One merit in particular many of them claim positively, that is, large air spaces. We admit and allow this claim when it first comes new from the foundry and clean before it is put in use; but we will venture the broad assertion that no dead or stationary bar ever has been constructed, or ever can or will be, that does not gradually fill up between the bars with small clinkers and hold up dirt and ashes, and thus seriously obstruct the draft and take from the bar quite a large portion of the boasted air space. In fact, we have known in time nearly one-half, if not more, of the boasted air space to be stopped up, and no help for it but to take out every bar separately and let the clinkers down or out. Now no such great difficulties occur with a good shaking or rocking grate. Parties who purchase coal, using a dead or stationary grate bar, many times think if their dead bars last a long time, they are money in pocket, when the truth is, the longer they use dead or stationary bar the more they are put out of pocket; the saving of fuel with any good shaking grate being some 10 to 20 per cent., showing that the stationary bar is a continual loss of money to those who continue to use them. These bars increase the boiler capacity at least 20 per cent. in power. For instance, a 50 horse boiler with a W. Ryder Patent Shaking Roller Grate will make as much steam, and steam as easy, and with less fuel, than a 60-horse boiler with a stationary grate. The above has been thoroughly tested.

W. RYDER MANUFACTURING CO., Garfield Building, Room 30, BROOKLYN, N. Y.

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Standard Quality SHEET, ROD, TUBING, INSULATOR HOOKS, KEY KNOBS, SWITCH HANDLES, TELEPHONE RECEIVERS and BATTERY SYRINGES constantly on hand. HARD RUBBER Specialties of all kinds Made to Order.

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